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*Indian Standard*

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# एस आई यूनिट में स्टीम टेबल

*( तीसरा पुनरीक्षण )*

# Steam Tables in SI Units

*( Third Revision )*

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## FOREWORD

This Special Publication (Third Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by Boilers and Pressure Vessels Sectional Committee had been approved by Mechanical Engineering Division Council.

This Special Publication was first published in 1966 and subsequently revised in 1983.

The assistance has been taken from the International publication as mentioned in Annex C.

The composition of the Committee responsible for the formulation of this standard is given in Annex D.

For the purpose of deciding whether a particular requirement of this Special Publication is complied with, the final value observed or calculated, expressing the result of a test, should be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values ( *revised* )'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Indian Standard*

# STEAM TABLES IN SI UNITS

*( Third Revision )*

## 1 SCOPE

This Special Publication covers the Steam Tables in SI units up to below mentioned range,

$$273.15\,\text{K} \le \text{T} \le 1\,073.15\,\text{KP} \le 100\,\text{MPa}$$

$$1\,073.15\,\text{K} < \text{T} \le 2\,273.15\,\text{K P} \le 50\,\text{MPa}$$

There are 11 Tables in all, arranged as follows; Table 1 to Table 7 relates to thermodynamic properties, Table 8 to Table 10 are related to transport properties of water and steam and Table 11 for other properties based on equations described in standard given in Annex A.

## 2 UNITS

The dominant system of units throughout the world is the international system of units abbreviated as SI. The SI contains seven 'base' units; these units and their combinations are used to express all physical quantities. These SI base units are given below. Other physical quantities are derived from appropriate combinations of these units:

| *Base Quantity* | *SI Base Units* | |
|---|---|---|
| | Name | Symbol |
| Length | Metre | M |
| Mass | Kilogram | kg |
| Time | Second | S |
| Electric current | Ampere | A |
| Thermodynamic temperature | Kelvin | K |
| Amount of substance | Mole | mol |
| Luminous intensity | Candela | cd |

## 3 NOMENCLATURE

$c_p$ Specific isobaric heat capacity
$c_v$ Specific isochoric heat capacity
$f$ Specific Helmholtz free energy
$g$ Specific Gibbs free energy
$h$ Specific enthalpy
$M$ Molar mass
$p$ Pressure
$R$ Specific gas constant
$R_m$ Molar gas constant
$s$ Specific entropy
$T$ Absolute temperature
$t$ Celsius temperature, $t = T - 273.15$ K
$u$ Specific internal energy
$v$ Specific volume
$w$ Speed of sound
$x$ General quantity
$\beta$ Transformed pressure
$\gamma$ Dimensionless Gibbs free energy, $\gamma = g/(RT)$
$\delta$ Reduced density, $\delta = \rho/\rho^*$
$\Delta$ Difference in any quantity
$\eta$ Reduced enthalpy, $\eta = h/h^*$
$\theta$ Reduced temperature, $\theta = T/T^*$
$\vartheta$ Transformed temperature
$\pi$ Reduced pressure, $\pi = p/p^*$
$\rho$ Mass density
$\sigma$ Reduced entropy, $\sigma = s/s^*$
$\tau$ Inverse reduced temperature, $\tau = T^*/T$
$\varphi$ Dimensionless Helmholtz free energy, $\varphi = f/(\text{RT})$

Superscripts:

$o$ Ideal-gas part
$r$ Residual part
$*$ Reducing quantity
$'$ Saturated liquid state
$''$ Saturated vapor state

Subscripts:

$c$ Critical point
$Max$ Maximum value
RMS Root-mean-square value
$s$ Saturation state
$t$ Triple point
tol Tolerance of a quantity

## 4 NEED FOR THE NEW INDUSTRIAL FORMULATION AND ADOPTION TO NEW FORMULATION

In 1997, the International Association for the Properties of Water and Steam (IAPWS) adopted a new formulation for the thermodynamic properties

of water and steam for industrial use. This new formulation, called IAPWS Industrial formulation 1997 (IAPWS-IF97) for the thermodynamic properties of water and steam, replaces the past industrial formulation, IFC-67. The formulation had been framed fundamentals for power plant calculations and other applications in energy engineering since the late 1960's. IAPWS-IF97 enhances altogether both the exactness and the speed of the computation of the thermodynamic properties compared with IFC-67.

So as to exhibit the requirement for a new industrial formulation, the attributes of the industrial formulation IFC-67 are considered (*see* 1 of Annex C). As appeared in Figure 4-1, the whole scope of legitimacy (273.15 K ≤ $T$ ≤ 1073.15 K for $p$ ≤ 100 MPa or 0 °C ≤ $t$ ≤ 800 °C for $p$ ≤ 100 MPa) was isolated into five regions with particular equations. For each of the region 1 (liquid) and 2 (vapour) there was an equation of the specific Gibbs free energy $g$ as function of pressure $p$ and temperature $T$, namely $g$ ( $p$, $T$). Each of the regions 3 and 4 was covered by an equation of the specific Helmholtz free energy $f$ as function of specific volume $v$ and temperature $T$, namely $f$ ($v$, $T$). The fifth region was the saturation curve for which a saturation-pressure equation $p_s(T)$ was given.

Based on the equations for the industrially most essential regions 1, 2, and 5, the accompanying properties could be directly calculated with IFC-67 as a function of $p$ and $T$: specific volume $v$, specific enthalpy $h$, specific entropy $s$ and specific isobaric heat capacity $c_p$, and moreover the saturation pressure $p_s$ as a function of $T$. If other combinations of variables were of interest, for example the combinations $v$ ($p$, $h$), $T$($p$, $h$), $s$ ($p$, $h$), $h$ ($p$, $s$), $T$($p$, $s$), and $T_S$($p$) for turbine-expansion calculations, these must be resolved by means of relating cycles. Because of these iterations in blend with a comparatively complex structure of the equations, calculations for the entire power cycle with the whole set of the IFC-67 equations required quite long process calculation times. Please *see* Fig illustrated below.

These days, with current mathematical tools to set up effective structures of such property formulations, the long process calculation times with the IFC-67 equations turned into a genuine shortcoming of this formulation. Other than this fundamental disadvantage of IFC-67, there were a few different lacks which are outlined (*see* 4 of Annex C):

a) For certain regions IFC-67 no longer met the present standard of accuracy.

b) For a few properties there were extensive irregularities at region boundaries.

c) The technically important property speed of sound $w$ was not consolidated in the set of the IFC-67 equations.

d) IFC-67 did not depend on the present International Temperature Scale (ITS-90).

e) IFC-67 depended on prior data and was thusly not associated with the present scientific standard of IAPWS for the thermodynamic properties of ordinary water substance, the IAPWS-95 formulation.

The IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam abbreviated IAPWS-IF97, was adopted at the 1997 IAPWS annual meeting in Erlangen, Germany. The entire sets of equations of IAPWS-IF97 have the same range of validity as given for IFC-67, except region 5 which is defined by the following temperature and pressure range:

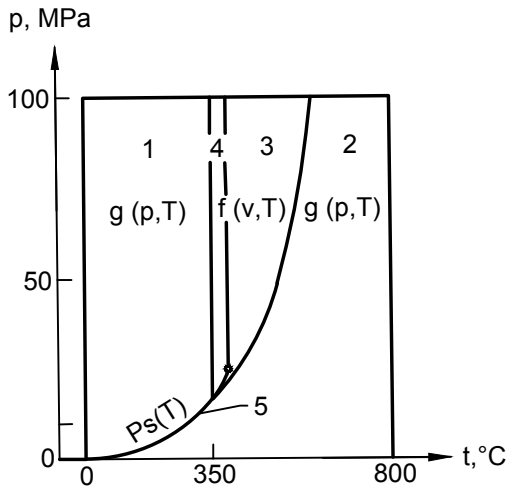



Fig. 4-1 Regions and Equotions of IFC - 6 the Boundary Between Regions 2 and 3 is Described by the L-Function

$$273.15\ \text{K} \leq T \leq 1\,073.15\ \text{K} \quad p \leq 100\ \text{MPa}$$

For high temperature applications such as in gas turbines the following extension of the range of validity is given:

$$1\,073.15\ \text{K} \leq T \leq 2\,273.15\ \text{K} \quad p \leq 10\ \text{MPa}$$

As innovation progressed and designs started to be considered for combustion turbines working at high pressures, IAPWS perceived the need to expand the pressure range applicability of the high temperature regions of IAPWS-IF97. The past fundamental equation for this region was substituted by a new equation of the similar structure and updated by IAPWS in 2007. For temperatures between 1 073.15 K and 2 273.15 K, this equation extends the upper range of validity of IAPWS-IF97 in pressure from 10 MPa to 50 MPa. With the exception of the basic equation for region 5 of IAPWS-IF97, the property calculations are unaltered.

The IAPWS Industrial Formulation 1997 comprises of a set of equations for various regions which cover the following range of validity:

$$273.15\ \text{K} \leq T \leq 1\,073.15\ \text{K} \quad p \leq 100\ \text{MPa}$$

$$1073.15\ \text{K} < T \leq 2\,273.15\ \text{K} \quad p \leq 50\ \text{MPa}$$

There are a number of important advantages which IAPWS-IF97 has over IFC-67; These includes following (*see* **17** of Annex C):

a) Improved Consistency at Interregional Boundaries

The new formulation has considerably smaller deviations at the region boundaries. For instance, the specific enthalpy deviation limit is ±0.2 kJ/kg. For the boundary between Regions 2 and 3, this epitomizes a maximum conceivable deviation of 0.008 percent of the specific enthalpy. This contrasts positively and the IFC-67 formulation in which deviations normal over 1 percent with a greatest deviation of 6.5 percent. This enhanced consistency will enormously encourage iterative estimations near region boundaries.

b) Better Agreement with Scientific Formulation (IAPWS 95)

IAPWS-IF97 was intended to be inside close resiliences of IAPWS-95, the cutting edge portrayal of steam properties. Contingent upon the region, these tolerances range from 0.01 percent to 0.3 percent for specific volume, 0.1 percent to 0.3 percent for specific enthalpy, 0.025 percent for saturation pressure, and 1 percent for specific isobaric heat capacity and speed of sound. IAPWS-IF97 was broadly tried and meets these tolerances at all points; often the agreement is vastly improved than these limits. Conversely, the IFC-67 has critical contrasts with the most recent formulation (and in this way with the real properties as best as is understood). A formulation that better characterizes the properties of real steam will at last prompt better design and operation.

c) Improved Calculation Speed

IAPWS-IF97 has been enhanced for better computational speed for the types of calculations performed most every now and then in industry. Extensive testing has demonstrated that, in spite of the fact that the targeted increase in speed was a factor of 3 (over IFC-67) in regions 1, 2, and 4, the actual test outcomes were 5.1 times faster. A lot of this change is due to the backward equations which diminish the requirement for tedious cycles. In region 3, no necessity was set for improved speed, but the test outcomes showed that calculations were 2.9 times faster. Region 5 did not exist for IFC-67; along the low-temperature border of Region 5 (the upper temperature confinement of IFC-67), IAPWS-IF97 was 8.9 times faster. The actual speed increase a user will experience is depends on the specific calculations to be performed. This increased speed will enable more detailed calculations to be performed with the same computing power, and will be especially helpful in computation-concentrated work such as finite-element analysis.

d) Agreement with ITS-90 International Temperature Scale

IAPWS-IF97 is based on the most recent standard temperature scale, ITS-90, which is a little enhancement toward better representing physical reality. Utilizing this temperature scale ensures consistency with the recognized international standard.

e) New High Temperature Region

Region 5 for IAPWS-IF97 will permit calculation of reliable steam properties in gas-turbine applications where water or steam injection is employed up to 2 273.15 K. IFC-67 did not cover this region. This is specifically compelling to advanced Brayton (gas turbine) and Rankine cycle designers. Note that, in this region, the dissociation of water into hydrogen and oxygen is small but not always insignificant. Be that as it may, the extent of this dissociation relies upon the amount of oxygen and hydrogen present in the gas, and is therefore variable. IAPWS, therefore, decided that there was no viable approach to account explicitly for dissociation in the formulation, leaving any alterations for dissociation up to the user.

f) Properties of Metastable Steam

In metastable calculations using IFC-67, the formulation used in the dry steam region was extrapolated into the normally wet region below the saturation line. This procedure gave a

consistent method of calculation, yet one that was not scientifically based. Amid the development of IAPWS-IF97, a Gibbs energy equation was established specifically for this metastable region. This equation has been extended successfully more profoundly into the sub-cooled region than is the case for the extrapolation of IFC-67 and is thought to give the best portrayal available for the metastable region. These distinctions may create small changes in some turbine calculations; as of now there are no experimental data to say definitively which formulation is closer to being 'right' in this regime.

g) Miscellaneous

The speed of sound is incorporated as a set of callable functions for each region. IFC-67, interestingly, does not offer a directly callable function. The speed of sound is imperative for different calculations, for instance, for the critical pressure ratio and amount of choked flow. The use of IAPWS-IF97 to produce densities as a function of temperature and pressure enables one to calculate viscosity and thermal conductivity with a high degree of consistency with the most recent IAPWS formulations for those properties, the utilization of IFC-67 would introduce moderate discrepancies for the transport properties.

## 5 THERMODYNAMIC PROPERTIES AND FORMULATION

The thermodynamic properties in this standard were calculated from the industrial formulation adopted in 1997 by the International Association for the Properties of Water and Steam (IAPWS). This formulation is the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam for Industrial Use, abbreviated as IAPWS-IF97. The IAPWS-IF97 consists of a set of equations for different regions. This structure is illustrated below in SI units.

Region 1 is the compressed liquid up to 623.15 K. Region 2 is the superheated vapor up to 1 073.15 K; it is separated from Region 3 by an equation relating pressure and temperature. Region 3 includes the critical region and is at pressures above the 2-3 boundary at temperatures above 623.15 K. Region 4 is the vapor-liquid saturation boundary (pressure vs. temperature), and extends to the critical temperature of 647.096 K. Region 5 represents high-temperature steam from 1 073.15 *K* to 2 273.15 K. Regions 1, 2, and 3 include pressures to 100 MPa, whereas Region 5 has a maximum pressure of 50 MPa. Regions 1, 2, and 5 use a Gibbs free energy equation where the independent variables are pressure and temperature, whereas Region 3 uses a Helmholtz free energy equation with independent variables mass density (or, equivalently, its reciprocal the specific volume) and temperature. In either case, all other thermodynamic properties (specific volume $v$, enthalpy $h$, entropy $s$, etc) may be obtained by appropriate differentiation and manipulation of the basic equation. For the enthalpy (and other quantities with dimensions of energy), and also for the entropy, only changes in the property are significant and the choice of a zero is arbitrary. As per the standard convention both the internal energy $u$ (related to the enthalpy by $h = u + pv$) and the entropy $s$ are defined to be zero for the saturated liquid at the triple-point temperature of 273.16 *K*.

Because different equations are used in different regions, there can be inconsistencies at the region boundaries. In developing IAPWS-IF97, great care was exercised to minimize the discrepancies in properties calculated at these boundaries. Extensive calculations were performed to ensure that they were within tolerances; the tolerances were chosen so that

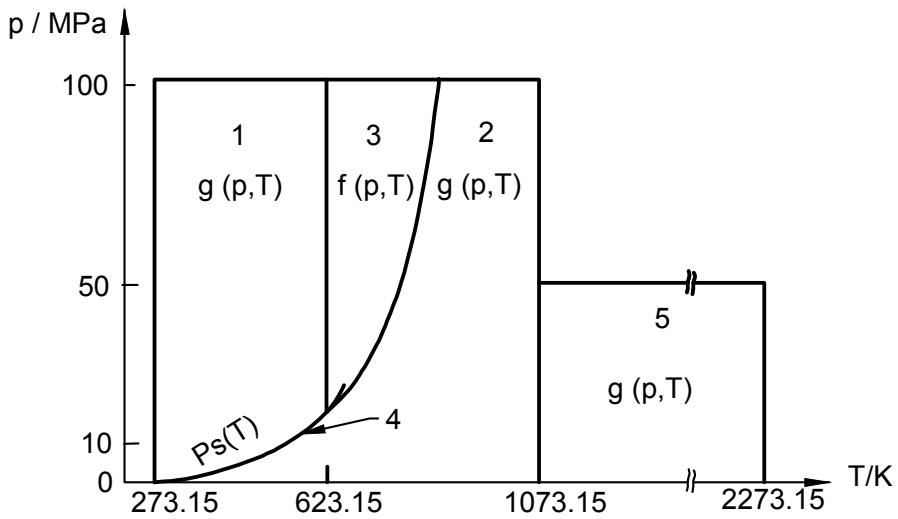



FIG. 5-1 STRUCTURE OF IAPWS- IF97

the discrepancies would not have an adverse effect on iterative calculations near the boundary.

### 5.1 Saturation Properties

Table 1 list the saturation pressure, specific volume, entropy, and enthalpy values for saturated vapor and liquid, as well as the changes in property values between these two states, as a function of temperature and extend from the freezing point to the critical point.

The saturation pressure is calculated at the given temperature using the IAPWS-IF97 equation for Region 4. This is in the form of an implicit quadratic equation so that it can be solved directly for $p(T)$ or $T(p)$. Once the saturation pressure is calculated, the saturation enthalpies, entropies, and specific volumes can be found for the liquid and vapour phases using the appropriate equations for Regions 1 and 2 for temperatures below 623.15 *K*. Above 623.15 *K*, the saturation properties are described by the equations for Region 3. In Region 3, an iterative technique must be used to converge on the values of the specific volume necessary to calculate the vapor and liquid properties at the saturation temperature and pressure.

Table 2 is similar to Table 1, except that pressure is the independent variable and the associated saturation temperature and values of the other properties at the given pressure are tabulated. An inverted form of the saturation equation for Region 4 is employed to obtain saturation temperature as a function of pressure. Once the temperature is obtained, the calculation technique for the remaining saturation quantities is the same as for Table 1 (*see* Annex A).

### 5.2 Superheated Steam and Compressed Water

Table 3 (*see* Annex A) presents the specific volume, enthalpy, and entropy of superheated steam and compressed water as functions of temperature and pressure; this table is arranged to provide isobaric (constant pressure) information. Table 3 has pressures ranging from 0.01 MPa to 100 MPa and temperatures from 273.15 K to 1 073.15 K. For subcritical pressures, the corresponding saturation temperature and the properties of the saturated liquid and vapor are shown at the beginning of each isobar. A horizontal line drawn between temperatures indicates the presence of a vapor-liquid transition.

The calculation procedure is to first determine the appropriate region, and then apply that region's equations to calculate all the tabulated properties. In Region 3, iterative techniques must be employed to determine properties at the given pressure and temperature.

### 5.3 Properties of Steam at High Temperatures

Table 4 (*see* Annex A) presents the specific volume, enthalpy, and entropy for high-temperature steam as functions of temperature and pressure (mostly Region 5, although a portion of Region 2 is included). Table 4 has pressures ranging from 0.01 MPa to 50 MPa and temperatures from 773.15 K to 2 273.15 K. The calculation procedure is to use Region 2 equations up to the Region 2 upper temperature boundary of 1 073.15 K, and then use the Region 5 equations to their upper bound of 2 273.15 K. This table is intended to supply properties for use with water or steam injection into high-temperature combustion gas turbines.

An important note is that IAPWS-IF97 gives properties for molecular water without any consideration of dissociation. At the high-temperature end of Region 5, dissociation can be significant, but its degree is dependent upon the hydrogen and oxygen concentrations in the fluid and would vary widely between applications. It is easier to begin with a pure substance and then correct for dissociation according to the specific conditions than to have a formulation that tries to correct for dissociation where that correction would need to be at least partially undone in many calculations. Therefore, IAPWS decided that it would be the responsibility of the user to correct for any dissociation of water in order to deal with the resulting gas solution.

### 5.4 Supersaturated Steam

In some cases, steam may become 'supersaturated'; this is a condition where the equilibrium state would be a vapor-liquid mixture but the fluid remains in a metastable vapor state. This can occur if a slightly superheated vapor is quickly expanded (and thereby cooled) to a lower pressure where liquid would be present at equilibrium; because of the rapid expansion, the liquid phase may not have sufficient time to form. During the development of IAPWS-IF97, it was discovered that the extrapolation of the basic Region 2 equation into this metastable region gave results that did not seem reasonable. IAPWS-IF97 therefore has a special equation (*see* **5.10.4.2**) for the metastable vapor at pressures below 10 MPa. Although there are no experimental data against which to compare this equation, the properties conform to turbine experience, and international experts have agreed that the equation provides a reasonable extrapolation of steam properties into this region.

Table 5 (*see* Annex A) shows the thermodynamic properties of superheated and supersaturated steam at pressures from 0.01 MPa to 10 MPa and from temperatures somewhat above saturation to a temperature corresponding to approximately 5 percent equilibrium moisture (where 'equilibrium moisture' is the liquid fraction that would result if the metastable fluid came to equilibrium with enthalpy and pressure fixed). The horizontal lines in the tables indicate the position of the equilibrium saturated vapor at that pressure. At temperatures above the line, the properties are computed from the equations for Region 2. At temperatures below the line, the special equation for the metastable vapor is used.

### 5.5 Isobaric Heat Capacity of Water and Steam

Table 6 (*see* Annex A) shows the isobaric heat capacity of water and steam. This quantity is also called the specific heat at constant pressure $c_p$. Table 6 shows the isobaric heat capacity in kJ $kg^{-1}$ $k^{-1}$ for temperatures and pressures in SI units. The reciprocal of the isobaric heat capacity is shown in graphical form in Fig. 1 (*see* Annex B). The values of $c_p$ are obtained from differentiation of the basic equation for the appropriate region; IAPWS-IF97 has specific subroutines for this property. Since the isobaric heat capacity involves a second derivative, it is sensitive to discrepancies at region boundaries and has small but noticeable discontinuities at some of the boundaries. These discontinuities have been graphically smoothed in the preparation of Fig. 1. The isobaric heat capacity is not defined within the two-phase (vapour-liquid) region

### 5.6 Speed of Sound in Water and Steam

Table 7 (*see* Annex A) shows the speed of sound in water and steam as a function of pressure and temperature, using the same pressures and temperatures as Tables 6. The speed of sound is shown in graphical form in Fig. 6 (*see* Annex B). These values are obtained from differentiation of the basic equation for the appropriate region; IAPWS-IF97 has specific subroutines for this property. As with the isobaric heat capacity, the speed of sound showed sensitivity to discontinuities at region boundaries and some minor smoothing was done in preparing the figures. The speed of sound is not a well-defined thermodynamic property within the two-phase region.

### 5.7 Isentropic Exponent

In some calculations of fluid expansions, the quantity $\gamma = -(V/p)(\partial p/\partial V)$, is used. This quantity is often referred to as the isentropic exponent because, as a first approximation (and exactly for an ideal gas) $pV^{\gamma}$, is constant for a short isentropic expansion. This quantity can be computed from the IAPWS-IF97 formulation and is shown in graphical form as a function of temperature and entropy in Fig. 7 (*see* Annex B).

### 5.8 Choked-Flow Calculations

An important industrial problem is the flow of fluid through nozzles, with reduction of pressure across the nozzle. Often, these flows can be considered to be isentropic. For a given upstream pressure, decreasing the downstream pressure increases the flow rate until a certain point; after that point (sometimes known as the 'critical pressure', not to be confused with the critical pressure associated with the end of the vapor-liquid saturation curve), further decreases in downstream pressure do not produce more flow. At this state, the flow is said to be "choked"; the velocity of the flow at that point is called the choking velocity.

The determination of choked flow involves finding a condition where the velocity divided by the specific volume (a ratio proportional to the mass flow rate) is maximized. The velocity used in this maximization is determined by assuming that the change in enthalpy in isentropic expansion from stagnant upstream conditions to the choked state is converted to kinetic energy of the fluid. For expansions taking place without any phase change, the choking velocity is simply equal to the speed of sound at the choked conditions.

Fig. 8 (*see* Annex B) shows the choking velocity (as a function of the enthalpy and either the pressure or the temperature) for superheated steam. Note, that the variables on this chart correspond to the choked conditions, not the inlet (upstream) conditions. As mentioned above, these one-phase choking velocities are equal to the speed of sound.

Fig. 9 (*see* Annex B) shows the choking velocity (again at the choked conditions) for expansions where the choked state is in the two-phase (vapour-liquid) region. The method of solution is the same; however, when the expansion ends in the two-phase region, the maximization of the flow rate behaves somewhat differently. This produces a discontinuity in the choking velocity at the saturated vapour boundary, as can be seen by comparing Fig. 8 to Fig. 9 (*see* Annex B). For more on choked flow in the two-phase region, (*see* [2] of Annex C). This calculation makes the simplifying assumption that the two-phase fluid is homogeneous and in equilibrium; this assumption becomes worse with increasing liquid fraction.

Fig. 10 (*see* Annex B) shows the choking mass flow rate as a function of enthalpy and pressure; this figure is drawn as a function of inlet conditions (pressure and enthalpy). The choking mass flow rate is the maximum flow rate per unit area and unit pressure drop that will be obtained at choked conditions for an expansion beginning at the given inlet conditions. The unusual 'humps' in the constant-pressure lines result from the transition of the choked conditions from one-phase to two-phase flow. As with the choking velocity, the calculation procedure assumes the two-phase choked flow to be homogeneous and in equilibrium.

### 5.9 Other Charts

In addition to the figures mentioned above and in **5.8**, this standard contains other charts of thermodynamic properties in formats that have historically been useful for industrial calculations. Fig. 11 (*see* Annex B) shows the isentropic work of compression, which is the enthalpy difference between a fluid state and that of the saturated liquid at the same entropy. Fig. 12 to 14 (*see* Annex B) all display the main thermodynamic quantities on different coordinate axes. Fig-12 has pressure and enthalpy as the axes (*p-h* chart), Fig. 13 (*see* Annex B) has temperature and entropy as the axes (*T-s* chart), and Fig. 14 (*see* Annex B) has enthalpy and entropy as the axes (*h-s* or Mollier chart).

**5.10 Structure of the Formulation**

The IAPWS-IF97 consists of a set of equations for different regions which cover the following range of temperature and pressure:

$$273.15\ \text{K} \le T \le 1\ 073.15\ \text{K}\quad p \le 100\ \text{MPa}$$

$$1073.15\ \text{K} < T \le 2\ 273.15\ \text{K}\quad p \le 50\ \text{MPa}$$

Figure given below **5** shows the five regions into which the entire range of validity of IAPWS-IF97 is divided. The boundaries of the regions can be directly taken from figure except for the boundary between regions 2 and 3; this boundary is defined by the so-called B 23-equation given in **5.10.2**. Both regions 1 and 2 are individually covered by a fundamental equation for the specific Gibbs free energy $g(p,T)$, region 3 by a fundamental equation for the specific Helmholtz free energy $f(\rho,T)$, where $\rho$ is the density, and the saturation curve by a saturation-pressure equation $p_s(T)$. The high-temperature region 5 is also covered by a $g(p,T)$ equation. The five equations, shown in rectangular boxes in above figure, form the so-called basic equations.

Regarding the main properties specific volume $v$, specific enthalpy $h$, specific isobaric heat capacity $c_p$, speed of sound $w$, and saturation pressure $p_s$, the basic equations represent the corresponding values from the "IAPWS Formulation 1995 for the Thermodynamic Properties of Ordinary Water Substance for General and Scientific Use" [*see* [3] of Annex C] (hereafter abbreviated to IAPWS-95) to within the tolerances specified for the development of the corresponding equations; details of these requirements and their fulfillment are given in the comprehensive paper on IAPWS-IF97 [*see* [4] of Annex C]. The basic equations for regions 1 and 3 also yield reasonable values for the metastable states close to the stable regions. For region 2 there is a special equation for the metastable-vapour region. Along the region boundaries the corresponding basic equations are consistent with each other within specified tolerances; for details *see* **5.6**.

In addition to the basic equations, for regions 1, 2, 3 and 4 so-called backward equations are provided in the forms of $T(p,h)$, $T(p,s)$ and $p(h,s)$ for regions 1 and 2, backward functions $T(h,s)$ for regions 1 and 2, backward equations $T(p,h)$, $v(p,h)$, $T(p,s)$, $v(p,s)$, $v(p,T)$, $p(h,s)$ and backward function $T(h,s)$ and $v(h,s)$ for region 3 and backward equations $T_s(p)$ and $T_s(h,s)$ and backward function $p_s(h,s)$ and $x(h,s)$ for region 4. These backward equations are numerically consistent with the corresponding basic equations and make the calculation of properties as functions of $p,h$ and of $p,s$ for regions 1 and 2, and of p for region 4, extremely fast. In this way, properties such as backward functions can be calculated without any iteration from the backward equation alone or by combination with the corresponding basic equation, for example, $h(p,s)$ *via* the relation $h(p,T(p,s))$. As a consequence, the calculation of the industrially most important properties is on average more than five times faster than the corresponding calculation with IFC-67.

The estimates of uncertainty of the most relevant properties calculated from the corresponding equations of IAPWS-IF97 are summarized in **5.7**.

**5.10.1** *Reference Constants*

The specific gas constant of ordinary water used for this formulation is:

$$\mathbf{R = 0.461526\ kJ\ kg^{-1}\ K^{-1}} \qquad \ldots (1)$$

This value results from the recommended values of the molar gas constant [*see* [5] of Annex C], and the molar mass of ordinary water [*see* [6] [7] of Annex C]. The values of the critical parameters

$$\boldsymbol{T_c = 647.096\ K} \qquad \ldots (2)$$

$$\boldsymbol{p_c = 22.064\ MPa} \qquad \ldots (3)$$

$$\boldsymbol{\rho_c = 322\ kg\ m^{-3}} \qquad \ldots (4)$$

are from the corresponding IAPWS release [*see* [8] of Annex C].

**5.10.2** *Auxiliary Equation for the Boundary between Regions 2 and 3*

The boundary between regions 2 and 3 (*see* Figure No. in **5**) is defined by the following simple quadratic pressure-temperature relation, the B23 equation

$$\pi = n_1 + n_2\theta + n_3\theta^2 \qquad \ldots (5)$$

Where $\pi = p/p^*$ and $\theta = T/T^*$ with $p^* = 1$ MPa and $T^* = 1$ K. The coefficients $n_1$ to $n_3$ of Eq. (5) are listed below. Eq. (5) roughly describes an isentropic line; the entropy values along this boundary line are between $s = 5.047$ kJ kg$^{-1}$ K$^{-1}$ and $s = 5.261$ kJ kg$^{-1}$ K$^{-1}$.

Alternatively Eq. (5) can be expressed explicitly in temperature as:

$$\theta = n_4 + [(\pi - n_5)/n_3]^{1/2} \qquad \ldots (6)$$

With $\theta$ and $\pi$ defined for Equation (5) and the coefficients $n_3$ to $n_5$ listed in Table below. Equation (5) and (6) cover the range from 623.15 *K* at a pressure of 16.529 2 *MPa* to 863.15 K at 100 MPa.

**Numerical Values of the Coefficients of Equations (5) and (6), for Defining the Boundary Between Regions 2 and 3**

| $i$ | $n_i$ |
|---|---|
| 1 | $0.348\ 051\ 856\ 289\ 69 \times 10^3$ |
| 2 | $-0.116\ 718\ 598\ 799\ 75 \times 10^1$ |
| 3 | $0.101\ 929\ 700\ 393\ 26 \times 10^{-2}$ |
| 4 | $0.572\ 544\ 598\ 627\ 46 \times 10^3$ |
| 5 | $0.139\ 188\ 397\ 788\ 70 \times 10^2$ |

**5.10.3** *Equations for Region 1*

This section contains all details relevant for the use of the basic and backward equations of region 1 of IAPWS-IF97. Information about the consistency of the basic equation of this region with the basic equations of regions 3 and 4 along the corresponding region boundaries is summarized in **5.6.** The estimates of uncertainty of the most relevant properties can be found in **5.7**.

**5.10.3.1** *Basic equation*

The basic equation for this region is a fundamental equation for the specific Gibbs free energy $g$. This equation is expressed in dimensionless form, $\gamma = g/(RT)$, and peruses.

$$\frac{g_1(p,T)}{RT} = \gamma(\pi,\tau) = \sum_{i=1}^{34} n_i (7.1-\pi)^{I_i} (\tau - 1.222)^{J_i} \quad ...(7)$$

Where $\pi = p/p^*$ and $\tau = T^*/T$ with $p^* = 16.53$ MPa and $T^*$=138 6 K; $R$ is given by Eq. (1). The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Eq. (7) are listed in following Table.

All thermodynamic properties can be derived from Equation (7) by using the appropriate combinations of the dimensionless Gibbs free energy and its derivatives. Relations between the relevant thermodynamic properties $\gamma$ and its derivatives are summarized in following Table.

**Numerical Values of the Coefficients and Exponents of the Dimensionless Gibbs Free Energy for Region 1, Equation (7)**

| $i$ | $I_i$ | $J_i$ | $n_i$ | $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|---|---|---|---|
| 1 | 0 | –2 | 0.146 329 712 131 67 | 18 | 2 | 3 | $-0.441\,418\,453\,308\,46 \times 10^{-5}$ |
| 2 | 0 | –1 | – 0.845 481 871 691 14 | 19 | 2 | 17 | $-0.726\,949\,962\,975\,94 \times 10^{-15}$ |
| 3 | 0 | 0 | $-0.375\,636\,036\,720\,40 \times 10^{1}$ | 20 | 3 | –4 | $-0.316\,796\,448\,450\,54 \times 10^{-4}$ |
| 4 | 0 | 1 | $0.338\,551\,691\,683\,85 \times 10^{1}$ | 21 | 3 | 0 | $-0.282\,707\,979\,853\,12 \times 10^{-5}$ |
| 5 | 0 | 2 | – 0.957 919 633 878 72 | 22 | 3 | 6 | $-0.852\,051\,281\,201\,03 \times 10^{-9}$ |
| 6 | 0 | 3 | 0.157 720 385 132 28 | 23 | 4 | –5 | $-0.224\,252\,819\,080\,00 \times 10^{-5}$ |
| 7 | 0 | 4 | $-0.166\,164\,171\,995\,01 \times 10^{-1}$ | 24 | 4 | –2 | $-0.651\,712\,228\,956\,01 \times 10^{-6}$ |
| 8 | 0 | 5 | $0.812\,146\,299\,835\,68 \times 10^{-3}$ | 25 | 4 | 10 | $-0.143\,417\,299\,379\,24 \times 10^{-12}$ |
| 9 | 1 | –9 | $0.283\,190\,801\,238\,04 \times 10^{-3}$ | 26 | 5 | –8 | $-0.405\,169\,968\,601\,17 \times 10^{-6}$ |
| 10 | 1 | –7 | $-0.607\,063\,015\,658\,74 \times 10^{-3}$ | 27 | 8 | –11 | $-0.127\,343\,017\,416\,41 \times 10^{-8}$ |
| 11 | 1 | –1 | $-0.189\,900\,682\,184\,19 \times 10^{-1}$ | 28 | 8 | –6 | $-0.174\,248\,712\,306\,34 \times 10^{-9}$ |
| 12 | 1 | 0 | $-0.325\,297\,487\,705\,05 \times 10^{-1}$ | 29 | 21 | –29 | $-0.687\,621\,312\,955\,31 \times 10^{-18}$ |
| 13 | 1 | 1 | $-0.218\,417\,171\,754\,14 \times 10^{-1}$ | 30 | 23 | –31 | $0.144\,783\,078\,285\,21 \times 10^{-19}$ |
| 14 | 1 | 3 | $-0.528\,383\,579\,699\,30 \times 10^{-4}$ | 31 | 29 | –38 | $0.263\,357\,816\,627\,95 \times 10^{-22}$ |
| 15 | 2 | –3 | $-0.471\,843\,210\,732\,67 \times 10^{-3}$ | 32 | 30 | –39 | $-0.119\,476\,226\,400\,71 \times 10^{-22}$ |
| 16 | 2 | 0 | $-0.300\,017\,807\,930\,26 \times 10^{-3}$ | 33 | 31 | –40 | $0.182\,280\,945\,814\,04 \times 10^{-23}$ |
| 17 | 2 | 1 | $0.476\,613\,939\,069\,87 \times 10^{-4}$ | 34 | 32 | –41 | $-0.935\,370\,872\,924\,58 \times 10^{-25}$ |

**Relations of Thermodynamic Properties to the Dimensionless Gibbs Free Energy $\gamma$ and its Derivatives[a] when Using Equation (7)**

| *Property* | *Relation* |
|---|---|
| Specific Volume<br>$v = (\partial g/\partial p)_T$ | $v(\pi,\tau)\dfrac{p}{RT} = \pi\gamma_\pi$ |
| Specific Internal Energy<br>$u = g - T(\partial g/\partial T)_p - p(\partial g/\partial p)_T$ | $\dfrac{u(\pi,\tau)}{RT} = \tau\gamma_\tau - \pi\gamma_\pi$ |
| Specific Entropy<br>$s = -(\partial g/\partial T)_p$ | $\dfrac{s(\pi,\tau)}{R} = \tau\gamma_\tau - \gamma$ |
| Specific Enthalpy<br>$h = g - T(\partial g/\partial T)_p$ | $\dfrac{h(\pi,\tau)}{RT} = \tau\gamma_\tau$ |
| Specific isobaric heat capacity<br>$c_p = (\partial h/\partial T)_p$ | $\dfrac{c_p(\pi,\tau)}{R} = -\tau^2\gamma_{\tau\tau}$ |
| Specific isochoric heat capacity<br>$c_v = (\partial u/\partial T)_v$ | $\dfrac{c_v(\pi,\tau)}{R} = -\tau^2\gamma_{\tau\tau} + \dfrac{(\gamma_\pi - \tau\gamma_{\pi\tau})^2}{\gamma_{\pi\pi}}$ |
| Speed of sound<br>$w = v\,[-(\partial p/\partial v)_s]^{1/2}$ | $\dfrac{w^2(\pi,\tau)}{RT} = \dfrac{\gamma^2\pi}{\dfrac{(\gamma_\pi - \tau\gamma_{\pi\tau})^2}{\tau^2\gamma_{\tau\tau}} - \gamma_{\pi\pi}}$ |
| [a] $\gamma_\pi = \left[\dfrac{\partial\gamma}{\partial\pi}\right]_\tau, \gamma_{\pi\pi} = \left[\dfrac{\partial^2\gamma}{\partial\pi^2}\right]_\tau, \gamma_\tau = \left[\dfrac{\partial\gamma}{\partial\tau}\right]_\pi, \gamma_{\tau\tau} = \left[\dfrac{\partial^2\gamma}{\partial\tau^2}\right]_\pi, \gamma_{\pi\tau} = \left[\dfrac{\partial^2\gamma}{\partial\pi\partial\tau}\right]$ | |

All required derivatives of the dimensionless Gibbs free energy are explicitly given in table below.

Since the 5th International Conference on the Properties of Steam in London in 1956, the specific internal energy and the specific entropy of the saturated liquid at the triple point have been set equal to zero:

$$u'_t = 0 \quad ; \quad s'_t = 0 \qquad \ldots (8)$$

In order to meet this condition at the temperature and pressure of the triple point.

$$T_t = 273.16 \text{ K} \quad ; \quad p_t = 611.657 \text{ Pa} \qquad \ldots (9)$$

the coefficients $n_3$ and $n_4$ in Equation (7) have been adjusted accordingly. As a consequence, Equation (7) yields for the specific enthalpy of the saturated liquid at the triple point.

$$h'_t = 0.611\,783 \text{ J kg}^{-1} \qquad \ldots (10)$$

**The Dimensionless Gibbs Free Energy $\gamma$ and its Derivatives[a] According to Equation (7)**

| | |
|---|---|
| $\gamma = \sum_{i=1}^{34} n_i (7.1-\pi)^{I_i} (\tau - 1.222)^{J_i}$ | |
| $\gamma_\pi = \sum_{i=1}^{34} -n_i I_i (7.1-\pi)^{I_i - 1} (\tau - 1.222)^{J_i}$ | $\gamma_{\pi\pi} = \sum_{i=1}^{34} n_i I_i (I_i - 1)(7.1-\pi)^{I_i - 2} (\tau - 1.222)^{J_i}$ |
| $\gamma_\tau = \sum_{i=1}^{34} n_i (7.1-\pi)^{I_i} J_i (\tau - 1.222)^{J_i - 1}$ | $\gamma_{\tau\tau} = \sum_{i=1}^{34} n_i (7.1-\pi)^{I_i} J_i (J_i - 1)(\tau - 1.222)^{J_i - 2}$ |
| $\gamma_{\pi\tau} = \sum_{i=1}^{34} -n_i I_i (7.1-\pi)^{I_i - 1} J_i (\tau - 1.222)^{J_i - 1}$ | |
| [a] $\gamma_\pi = \left[\frac{\partial \gamma}{\partial \pi}\right]_\tau$, $\gamma_{\pi\pi} = \left[\frac{\partial^2 \gamma}{\partial \pi^2}\right]_\tau$, $\gamma_\tau = \left[\frac{\partial \gamma}{\partial \tau}\right]_\pi$, $\gamma_{\tau\tau} = \left[\frac{\partial^2 \gamma}{\partial \tau^2}\right]_\pi$, $\gamma_{\pi\tau} = \left[\frac{\partial^2 \gamma}{\partial \pi \partial \tau}\right]$ | |

1) *Range of Validity*

Equation (7) covers region 1 of IAPWS-IF97 defined by the following range of temperature and pressure; *see* Fig. no. in **5**:

273.15 K ≤ $T$ ≤ 623.15 K$p_s$ (T) ≤ $p$ ≤ 100 MPa

In addition to the properties in the stable single-phase liquid region, Equation (7) also yields reasonable values in the metastable superheated-liquid region close to the saturated liquid line.

NOTE — For temperatures between 273.15 K and 273.16 K, the part of the range of validity between the pressures on the melting line [9] and on the saturation-pressure line, Equation (52), corresponds to metastable states.

**5.10.3.2** *Backward equations*

For the calculation of properties as function of $p$, $h$ or of $p$, $s$ or of $h$, $s$ without any iteration, the two backward equations require extremely good numerical consistency with the basic equation. The exact requirements for these numerical consistencies were obtained from comprehensive test calculations for several characteristic power cycles. The result of these investigations, namely the assignment of the tolerable numerical inconsistencies between the basic equation, Equation (7), and the corresponding backward equations, is given in Equations (12) and (14).

Backward Equation $T$ ($p$,$h$)

The backward equation $T$ ($p$,$h$) for region 1 has the following dimensionless form:

$$\frac{T_1(p,h)}{T^*} = \theta(\pi,\eta) = \sum_{i=1}^{20} n_i \pi^{I_i} (\eta + 1)^{J_i} \quad ...(11)$$

Where, $\theta = T/T^*$, $\pi = p/p^*$, and $\eta = h/h^*$ with $T^*$ = 1 K, $p^*$ = 1 MPa, and $h^*$ = 250 0 kJ kg$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Eq. (11) are listed in the following table.

1) *Range of Validity*

Equation (11) covers the same range of validity as the basic equation, Equation (7), except for the metastable region (superheated liquid), where Equation (11) is not valid.

2) *Numerical Consistency with the Basic Equation*

For ten million random pairs of $p$ and $h$ covering the entire region 1, the differences $\Delta T$ between temperatures from Equation (11) and from Equation (7) were calculated and the absolute maximum difference $|\Delta T|_{max}$ and the root-mean-square difference $\Delta T_{RMS}$ were determined. These actual inconsistency values and the tolerated value $|\Delta T|_{tol}$ (*see* the beginning of **5.10.3.2**) amount to:

$|\Delta T|_{tol}$ = 25 mK ; $\Delta T_{RMS}$ = 13.4 mK ; $|\Delta T|_{max}$ = 23.6 mK … (12)

Backward Equation $T$ ($p$,$s$)

The backward equation $T$($p$,$s$) for region 1 has the following dimensionless form:

$$\frac{T(p,s)}{T^*} = \theta(\pi,\sigma) = \sum_{i=1}^{20} n_i \pi^{I_i} (\sigma + 2)^{J_i} \quad ... (13)$$

Where, $\theta = T/T^*$, $\pi = p/p^*$, and $\sigma = s/s^*$ with $T^*$ = 1 $K$, $p^*$ = 1 $MPa$, and $s^*$ = 1 $kJ\ kg^{-1}\ K^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (13) are listed in following table.

**Numerical Values of the Coefficients and Exponents of the Backward Equation *T*(*p*,*h*) for Region 1, Equation (11)**

| $i$ | $I_i$ | $J_i$ | $n_i$ | $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | $-0.238\,724\,899\,245\,21 \times 10^{3}$ | 11 | 1 | 4 | $-0.659\,647\,494\,236\,38 \times 10^{1}$ |
| 2 | 0 | 1 | $0.404\,211\,886\,379\,45 \times 10^{3}$ | 12 | 1 | 10 | $0.939\,654\,008\,783\,63 \times 10^{-2}$ |
| 3 | 0 | 2 | $0.113\,497\,468\,817\,18 \times 10^{3}$ | 13 | 1 | 32 | $0.115\,736\,475\,053\,40 \times 10^{-6}$ |
| 4 | 0 | 6 | $-0.584\,576\,160\,480\,39 \times 10^{1}$ | 14 | 2 | 10 | $-0.258\,586\,412\,820\,73 \times 10^{-4}$ |
| 5 | 0 | 22 | $-0.152\,854\,824\,131\,40 \times 10^{-3}$ | 15 | 2 | 32 | $-0.406\,443\,630\,847\,99 \times 10^{-8}$ |
| 6 | 0 | 32 | $-0.108\,667\,076\,953\,77 \times 10^{-5}$ | 16 | 3 | 10 | $0.664\,561\,861\,916\,35 \times 10^{-7}$ |
| 7 | 1 | 0 | $-0.133\,917\,448\,726\,02 \times 10^{2}$ | 17 | 3 | 32 | $0.806\,707\,341\,030\,27 \times 10^{-10}$ |
| 8 | 1 | 1 | $0.432\,110\,391\,835\,59 \times 10^{2}$ | 18 | 4 | 32 | $-0.934\,777\,712\,139\,47 \times 10^{-12}$ |
| 9 | 1 | 2 | $-0.540\,100\,671\,705\,06 \times 10^{2}$ | 19 | 5 | 32 | $0.582\,654\,420\,206\,01 \times 10^{-14}$ |
| 10 | 1 | 3 | $0.305\,358\,922\,039\,16 \times 10^{2}$ | 20 | 6 | 32 | $-0.150\,201\,859\,535\,03 \times 10^{-16}$ |

**Numerical Values of the Coefficients and Exponents of the Backward Equation *T*(*p*,*s*) for Region 1, Equation (13)**

| $i$ | $I_i$ | $J_i$ | $n_i$ | $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | $0.174\,782\,680\,583\,07 \times 10^{3}$ | 11 | 1 | 12 | $0.356\,721\,106\,073\,66 \times 10^{-9}$ |
| 2 | 0 | 1 | $0.348\,069\,308\,928\,73 \times 10^{2}$ | 12 | 1 | 31 | $0.173\,324\,969\,948\,95 \times 10^{-23}$ |
| 3 | 0 | 2 | $0.652\,925\,849\,784\,55 \times 10^{1}$ | 13 | 2 | 0 | $0.566\,089\,006\,548\,37 \times 10^{-3}$ |
| 4 | 0 | 3 | $0.330\,399\,817\,754\,89$ | 14 | 2 | 1 | $-0.326\,354\,831\,397\,17 \times 10^{-3}$ |
| 5 | 0 | 11 | $-0.192\,813\,829\,231\,96 \times 10^{-6}$ | 15 | 2 | 2 | $0.447\,782\,866\,906\,32 \times 10^{-4}$ |
| 6 | 0 | 31 | $-0.249\,091\,972\,445\,73 \times 10^{-22}$ | 16 | 2 | 9 | $-0.513\,221\,569\,085\,07 \times 10^{-9}$ |
| 7 | 1 | 0 | $-0.261\,076\,364\,893\,32$ | 17 | 2 | 31 | $-0.425\,226\,570\,422\,07 \times 10^{-25}$ |
| 8 | 1 | 1 | $0.225\,929\,659\,815\,86$ | 18 | 3 | 10 | $0.264\,004\,413\,606\,89 \times 10^{-12}$ |
| 9 | 1 | 2 | $-0.642\,564\,633\,952\,26 \times 10^{-1}$ | 19 | 3 | 32 | $0.781\,246\,004\,597\,23 \times 10^{-28}$ |
| 10 | 1 | 3 | $0.788\,762\,892\,705\,26 \times 10^{-2}$ | 20 | 4 | 32 | $-0.307\,321\,999\,036\,68 \times 10^{-30}$ |

1) *Range of Validity*

Equation (13) covers the same range of validity as the basic equation, Equation (7), except for the metastable region (superheated liquid), where Equation (13) is not valid.

2) *Numerical Consistency with the Basic Equation*

For ten million random pairs of $p$ and $s$ covering the entire region 1, the differences $\Delta T$ between temperatures from Equation (13) and from Equation (7) were calculated and the absolute maximum difference $|\Delta T|_{max}$ and the root-mean-square difference $\Delta T_{RMS}$ were determined. These actual differences and the tolerated value $|\Delta T|_{tol}$. (*see* the beginning of clause **5.10.3.2**) amount to:

$$|\Delta T|_{tol} = 25 \text{ mK} \; ; \; \Delta T_{RMS} = 5.8 \text{ mK} \; ; \; |\Delta T|_{max} = 21.8 \text{ mK} \quad \ldots (14)$$

Backward Equation $p$ ($h$,$s$)

The backward equation $p(h,s)$ for region 1 has the following dimensionless form:

$$\frac{p_1(h,s)}{p^*} = \pi(\eta,\sigma) = \sum_{i=1}^{19} n_i (\eta + 0.05)^{I_i} (\sigma + 0.05)^{J_i} \quad \ldots (15)$$

Where, $\pi = p/p^*$, $\eta = h/h^*$, and $\sigma = s/s^*$ with $p^* = 100$ MPa, $h^* = 340\ 0$ kJ kg$^{-1}$, and $s^* = 7.6$ kJ kg$^{-1}$ K$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (15) are listed in following table.

1) *Numerical Consistency with the Basic Equation*

The maximum pressure differences and related root-mean-square differences between $p_1$ (***h,s***), Equation (15), and the basic equation $g_1$ (***p, T***) for pressures less than or equal to 2.5 MPa or greater than this value are listed in following table.

**Numerical Values of the Coefficients and Exponents of the Backward Equation $p(h,s)$ for Region 1, Equation (15)**

| $i$ | $I_i$ | $J_i$ | $n_i$ | $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | – 0.691 997 014 660 582 | 11 | 1 | 4 | – 0.319 947 848 334 300 × $10^3$ |
| 2 | 0 | 1 | – 0.183 612 548 787 560 × $10^2$ | 12 | 1 | 6 | – 0.928 354 307 043 320 × $10^3$ |
| 3 | 0 | 2 | – 0.928 332 409 297 335 × $10^1$ | 13 | 2 | 0 | 0.303 634 537 455 249 × $10^2$ |
| 4 | 0 | 4 | 0.659 639 569 909 906 × $10^2$ | 14 | 2 | 1 | – 0.650 540 422 444 146 × $10^2$ |
| 5 | 0 | 5 | – 0.162 060 388 912 024 × $10^2$ | 15 | 2 | 10 | – 0.430 991 316 516 130 × $10^4$ |
| 6 | 0 | 6 | 0.450 620 017 338 667 × $10^3$ | 16 | 3 | 4 | – 0.747 512 324 096 068 × $10^3$ |
| 7 | 0 | 8 | 0.854 680 678 224 170 × $10^3$ | 17 | 4 | 1 | 0.730 000 345 529 245 × $10^3$ |
| 8 | 0 | 14 | 0.607 523 214 001 162 × $10^4$ | 18 | 4 | 4 | 0.114 284 032 569 021 × $10^4$ |
| 9 | 1 | 0 | 0.326 487 682 621 856 × $10^2$ | 19 | 5 | 0 | – 0.436 407 041 874 559 × $10^3$ |
| 10 | 1 | 1 | – 0.269 408 844 582 931 × $10^2$ | | | | |

**Maximum Differences $|\Delta p|_{max}$ and Root-Mean-Square $\Delta p_{RMS}$ Differences Between Pressures Calculated from Equations (15) and $g_1(p,T)$ in Comparison with the Tolerated Differences $|\Delta p|_{tol}$**

| | $\|\Delta p\|_{tol}$ | $\|\Delta p\|_{max}$ | $\Delta p_{RMS}$ |
|---|---|---|---|
| $p \leq 2.5\ MPa$ | 0.60 % | 0.55 % | 0.11 % |
| $p > 2.5\ MPa$ | 15 $kPa$ | 14 $kPa$ | 6 $kPa$ |

**5.10.4** *Equations for Region 2*

This section contains all details relevant for the use of the basic and backward equations of region 2 of IAPWS-IF97. Information about the consistency of the basic equation of this region with the basic equations of regions 3, 4 and 5 along the corresponding region boundaries is summarized in para. 6. The auxiliary equation for defining the boundary between regions 2 and 3 is given in **5.10.2**. The estimates of uncertainty of the most relevant properties can be found in clause **5.7**.

**5.10.4.1** *Basic equation*

The basic equation for this region is a fundamental equation for the specific Gibbs free energy $g$. This equation is expressed in dimensionless form, $\gamma = g/(RT)$, and is separated into two parts, an ideal-gas part $\gamma^o$ and a residual part $\gamma^r$, so that:

$$\frac{g_2(p,T)}{RT} = \gamma(\pi,\tau) = \gamma^o(\pi,\tau) + \gamma^r(\pi,\tau) \quad \text{...(16)}$$

Where $\pi = p/p^*$ and $\tau = T^*/T$ with $R$ given by Equation (1).

The equation for the ideal-gas part $\gamma^o$ of the dimensionless Gibbs free energy peruses

$$\gamma^o = \ln \pi + \sum_{i=1}^{9} n_i^o \tau^{J_i^o} \quad \text{...(17)}$$

Where $\pi = p/p^*$ and $\tau = T^*/T$ with $p^* = 1$ MPa and $T^* = 540$ K. The coefficients $n_1^0$ and $n_2^0$ were adjusted in such a way that the values for the specific internal energy and specific entropy in the ideal-gas state relate to Equation (8). The following table contains the coefficients $n_1^0$ and exponents $J_i^0$ of Equation (17).

[a]If Equation (17) is incorporated into Equation (19), instead of the values for $n_1^0$ and $n_2^0$ given above, the following values for these two coefficients must be used: $n_1^0 = -0.969\,372\,683\,930\,49 \times 10^1$, $= n_2^0\ 0.100\,872\,759\,700\,06 \times 10^2$.

The form of the residual part $\gamma^r$ of the dimensionless Gibbs free energy is as follows:

$$\gamma^r = \sum_{i=1}^{43} n_i \pi^{I_i} (\tau - 0.5)^{J_i} \quad \text{...(18)}$$

Where $\pi = p/p^*$ and $\tau = T^*/T$ with $p^* = 1$ MPa and $T^* = 540$ K. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (18) are listed in the following table.

**Numerical Values of the Coefficients and Exponents of the Ideal-Gas Part $\gamma^o$ of the Dimensionless Gibbs Free Energy for Region 2, Equation (17)[a]**

| $i$ | $J_i^0$ | $n_1^0$ | $i$ | $J_i^0$ | $n_1^0$ |
|---|---|---|---|---|---|
| 1[a] | 0 | – 0.969 276 865 002 17 × $10^1$ | 6 | – 2 | 0.142 408 191 714 44 × $10^1$ |
| 2[a] | 1 | 0.100 866 559 680 18 × $10^2$ | 7 | – 1 | – 0.438 395 113 194 50 × $10^1$ |
| 3 | – 5 | – 0.560 879 112 830 20 × $10^{-2}$ | 8 | 2 | – 0.284 086 324 607 72 |
| 4 | – 4 | 0.714 527 380 814 55 × $10^{-1}$ | 9 | 3 | 0.212 684 637 533 07 × $10^{-1}$ |
| 5 | – 3 | – 0.407 104 982 239 28 | – | – | – |

**Numerical Values of the Coefficients and Exponents of the Residual Part $\gamma^r$ of the Dimensionless Gibbs Free Energy for Region 2, Equation (18)**

| $i$ | $I_i$ | $J_i$ | $n_i$ | $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 0 | – 0.177 317 424 732 13 × $10^{-2}$ | 23 | 7 | 0 | – 0.590 595 643 242 70 × $10^{-17}$ |
| 2 | 1 | 1 | – 0.178 348 622 923 58 × $10^{-1}$ | 24 | 7 | 11 | – 0.126 218 088 991 01 × $10^{-5}$ |
| 3 | 1 | 2 | – 0.459 960 136 963 65 × $10^{-1}$ | 25 | 7 | 25 | – 0.389 468 424 357 39 × $10^{-1}$ |
| 4 | 1 | 3 | – 0.575 812 590 834 32 × $10^{-1}$ | 26 | 8 | 8 | 0.112 562 113 604 59 × $10^{-10}$ |
| 5 | 1 | 6 | – 0.503 252 787 279 30 × $10^{-1}$ | 27 | 8 | 36 | – 0.823 113 408 979 98 × $10^1$ |
| 6 | 2 | 1 | – 0.330 326 416 702 03 × $10^{-4}$ | 28 | 9 | 13 | 0.198 097 128 020 88 × $10^{-7}$ |
| 7 | 2 | 2 | – 0.189 489 875 163 15 × $10^{-3}$ | 29 | 10 | 4 | 0.104 069 652 101 74 × $10^{-18}$ |
| 8 | 2 | 4 | – 0.393 927 772 433 55 × $10^{-2}$ | 30 | 10 | 10 | – 0.102 347 470 959 29 × $10^{-12}$ |
| 9 | 2 | 7 | – 0.437 972 956 505 73 × $10^{-1}$ | 31 | 10 | 14 | – 0.100 181 793 795 11 × $10^{-8}$ |
| 10 | 2 | 36 | – 0.266 745 479 140 87 × $10^{-4}$ | 32 | 16 | 29 | – 0.808 829 086 469 85 × $10^{-10}$ |
| 11 | 3 | 0 | 0.204 817 376 923 09 × $10^{-7}$ | 33 | 16 | 50 | 0.106 930 318 794 09 |
| 12 | 3 | 1 | 0.438 706 672 844 35 × $10^{-6}$ | 34 | 18 | 57 | – 0.336 622 505 741 71 |
| 13 | 3 | 3 | – 0.322 776 772 385 70 × $10^{-4}$ | 35 | 20 | 20 | 0.891 858 453 554 21 × $10^{-24}$ |
| 14 | 3 | 6 | – 0.150 339 245 421 48 × $10^{-2}$ | 36 | 20 | 35 | 0.306 293 168 762 32 × $10^{-12}$ |
| 15 | 3 | 35 | – 0.406 682 535 626 49 × $10^{-1}$ | 37 | 20 | 48 | – 0.420 024 676 982 08 × $10^{-5}$ |
| 16 | 4 | 1 | – 0.788 473 095 593 67 × $10^{-9}$ | 38 | 21 | 21 | – 0.590 560 296 856 39 × $10^{-25}$ |
| 17 | 4 | 2 | 0.127 907 178 522 85 × $10^{-7}$ | 39 | 22 | 53 | 0.378 269 476 134 57 × $10^{-5}$ |
| 18 | 4 | 3 | 0.482 253 727 185 07 × $10^{-6}$ | 40 | 23 | 39 | – 0.127 686 089 346 81 × $10^{-14}$ |
| 19 | 5 | 7 | 0.229 220 763 376 61 × $10^{-5}$ | 41 | 24 | 26 | 0.730 876 105 950 61 × $10^{-28}$ |
| 20 | 6 | 3 | – 0.167 147 664 510 61 × $10^{-10}$ | 42 | 24 | 40 | 0.554 147 153 507 78 × $10^{-16}$ |
| 21 | 6 | 16 | – 0.211 714 723 213 55 × $10^{-2}$ | 43 | 24 | 58 | – 0.943 697 072 412 10 × $10^{-6}$ |
| 22 | 6 | 35 | – 0.238 957 419 341 04 × $10^2$ | | | | |

All thermodynamic properties can be derived from Equation (16) by using the appropriate combinations of the ideal-gas part $\gamma^o$, Equation (17), and the residual part $\gamma^r$, Equation (18), of the dimensionless Gibbs free energy and their derivatives. Relations between the relevant thermodynamic properties and $\gamma^o$ and $\gamma^r$ and their derivatives are summarized in following table.

1) *Range of Validity*

Equation (16) covers region 2 of IAPWS-IF97 defined by the following range of temperature and pressure:

$$273.15\ \text{K} \le \text{T} \le 623.15\ K\ 0 < p \le p_s\ (\text{T})_{Eq.(52)}$$

$$623.15\ \text{K} < \text{T} \le 863.15\ K\ 0 < p \le p\ (\text{T})_{Eq.(5)}$$

$$863.15\ \text{K} < T \le 1\ 073.15\ K\ 0 < p \le 100\ \text{MPa}$$

In addition to the properties in the stable single-phase vapour region, Eq. (16) also yields reasonable values in the metastable-vapour region for pressures above. Equation (16) is not valid in the metastable-vapour region at pressures; $p \leq 10$ MPa for this part of the metastable-vapour region *see* **5.10.4.2**.

NOTE — For temperatures between 273.15 K and 273.16 K, the part of the range of validity between the pressures on the saturation-pressure line, Equation (52), and on the sublimation line [9] corresponds to metastable states.

All required derivatives of the ideal-gas part and of the residual part of the dimensionless Gibbs free energy are explicitly given in following tables respectively.

**Relations of Thermodynamic Properties to the Ideal-Gas Part $\gamma^o$ and the Residual Part $\gamma^r$ of the Dimensionless Gibbs Free Energy and their Derivatives[a] when Using Equation (16) or Equation (19)**

| *Property* | *Relation* |
|---|---|
| Specific Volume<br>$v = (\partial g/\partial p)_T$ | $v(\pi,\tau)\dfrac{p}{RT} = \pi\left(\gamma_\pi^o + \gamma_\pi^r\right)$ |
| Specific Internal Energy<br>$u = g - T(\partial g/\partial T)_p - p(\partial g/\partial p)_T$ | $\dfrac{u(\pi,\tau)}{RT} = \tau\left(\gamma_\tau^o + \gamma_\tau^r\right) - \pi\left(\gamma_\pi^o + \gamma_\pi^r\right)$ |
| Specific Entropy<br>$s = -(\partial g/\partial T)_p$ | $\dfrac{s(\pi,\tau)}{R} = \tau\left(\gamma_\tau^o + \gamma_\tau^r\right) - \left(\gamma^o + \gamma^r\right)$ |
| Specific Enthalpy<br>$h = g - T(\partial g/\partial T)_p$ | $\dfrac{h(\pi,\tau)}{RT} = \tau\left(\gamma_\tau^o + \gamma_\tau^r\right)$ |
| Specific isobaric heat capacity<br>$c_p = (\partial h/\partial T)_p$ | $\dfrac{c_p(\pi,\tau)}{R} = -\tau^2\left(\gamma_{\tau\tau}^o + \gamma_{\tau\tau}^r\right)$ |
| Specific isochoric heat capacity<br>$c_v = (\partial u/\partial T)_v$ | $\dfrac{c_v(\pi,\tau)}{R} = -\tau^2\left(\gamma_{\tau\tau}^o + \gamma_{\tau\tau}^r\right) - \dfrac{\left(1+\pi\gamma_\pi^r - \tau\pi\gamma_{\pi\tau}^r\right)^2}{1-\pi^2\gamma_{\pi\pi}^r}$ |
| Speed of sound<br>$w = v\,[-(\partial p/\partial v)_s]^{1/2}$ | $\dfrac{w^2(\pi,\tau)}{RT} = \dfrac{1+2\pi\gamma_\pi^r + \pi^2\gamma_\pi^{r2}}{\left(1-\pi^2\gamma_{\pi\pi}^r\right) + \dfrac{\left(1+\pi\gamma_\pi^r - \tau\pi\gamma_{\pi\tau}^r\right)^2}{\tau^2(\gamma_{\tau\tau}^o + \gamma_{\tau\tau}^{r)}}}$ |

[a] $\gamma_\pi^r = \left[\dfrac{\partial\gamma^r}{\partial\pi}\right]_\tau$, $\gamma_{\pi\pi}^r = \left[\dfrac{\partial^2\gamma^r}{\partial\pi^2}\right]_\tau$, $\gamma_\tau^r = \left[\dfrac{\partial\gamma^r}{\partial\tau}\right]_\pi$, $\gamma_{\tau\tau}^r = \left[\dfrac{\partial^2\gamma^r}{\partial\tau^2}\right]_\pi$, $\gamma_{\pi\tau}^r = \left[\dfrac{\partial^2\gamma^r}{\partial\pi\partial\tau}\right]$,

$\gamma_\tau^o = \left[\dfrac{\partial\gamma^o}{\partial\tau}\right]_\pi$, $\gamma_{\tau\tau}^o = \left[\dfrac{\partial^2\gamma^o}{\partial\tau^2}\right]_\pi$

**Ideal-Gas Part $\gamma^o$ of the Dimensionless Gibbs Free Energy and its Derivatives [a] According to Equation (17)**

| |
|---|
| $\gamma^o = \ln \pi + \sum_{i=1}^{9} n_i^o \tau^{J_i^o}$ |
| $\gamma_\pi^o = \frac{1}{\pi} + 0$ |
| $\gamma_{\pi\pi}^o = -\frac{1}{\pi^2} + 0$ |
| $\gamma_\tau^o = 0 + \sum_{i=1}^{9} n_i^o J_i^o \tau^{J_i^o - 1}$ |
| $\gamma_{\tau\tau}^o = 0 + \sum_{i=1}^{9} n_i^o J_i^o \left(J_i^o - 1\right) \tau^{J_i^o - 2}$ |
| $\gamma_{\pi\tau}^o = 0 + 0$ |
| [a] $\gamma_\pi^o = \left[\frac{\partial \gamma^o}{\partial \pi}\right]_\tau$, $\gamma_{\pi\pi}^o = \left[\frac{\partial^2 \gamma^o}{\partial \pi^2}\right]_\tau$, $\gamma_\tau^o = \left[\frac{\partial \gamma^o}{\partial \tau}\right]_\pi$, $\gamma_{\tau\tau}^o = \left[\frac{\partial^2 \gamma^o}{\partial \tau^2}\right]_\pi$, $\gamma_{\pi\tau}^o = \left[\frac{\partial^2 \gamma^o}{\partial \pi \partial \tau}\right]$ |

**Residual Part $\gamma^r$ of the Dimensionless Gibbs Free Energy and its Derivatives[a] According to Equation (18)**

| | |
|---|---|
| $\gamma^r = \sum_{i=1}^{43} n_i \pi^{I_i} \left(\tau - 0.5\right)^{J_i}$ | |
| $\gamma_\pi^r = \sum_{i=1}^{43} n_i I_i \pi^{I_i - 1} \left(\tau - 0.5\right)^{J_i}$ | $\gamma_{\pi\pi}^r = \sum_{i=1}^{43} n_i I_i \left(I_i - 1\right) \pi^{I_i - 2} \left(\tau - 0.5\right)^{J_i}$ |
| $\gamma_\tau^r = \sum_{i=1}^{43} n_i \pi^{I_i} J_i \left(\tau - 0.5\right)^{J_i - 1}$ | $\gamma_{\tau\tau}^r = \sum_{i=1}^{43} n_i \pi^{I_i} J_i \left(J_i - 1\right)\left(\tau - 0.5\right)^{J_i - 2}$ |
| $\gamma_{\pi\tau}^r = \sum_{i=1}^{43} n_i I_i \pi^{I_i - 1} J_i \left(\tau - 0.5\right)^{J_i - 1}$ | |
| [a] $\gamma_\pi^r = \left[\frac{\partial \gamma^r}{\partial \pi}\right]_\tau$, $\gamma_{\pi\pi}^r = \left[\frac{\partial^2 \gamma^r}{\partial \pi^2}\right]_\tau$, $\gamma_\tau^r = \left[\frac{\partial \gamma^r}{\partial \tau}\right]_\pi$, $\gamma_{\tau\tau}^r = \left[\frac{\partial^2 \gamma^r}{\partial \tau^2}\right]_\pi$, $\gamma_{\pi\tau}^r = \left[\frac{\partial^2 \gamma^r}{\partial \pi \partial \tau}\right]$ | |

**5.10.4.2** *Supplementary equation for the metastable-vapour region*

As for the basic equation, Equation (16), the supplementary equation for a part of the metastable-vapour region bounding region 2 is given in the dimensionless form of the specific Gibbs free energy, $\gamma = g/RT$, consisting of an ideal-gas part $\gamma^o$ and a residual part $\gamma^r$, so that

$$\frac{g_2(p,T)}{RT} = \gamma(\pi,\tau) = \gamma^o(\pi,\tau) + \gamma^r(\pi,\tau) \quad ...(19)$$

Where $\pi = p/p^*$ and $\tau = T^*/T$ with given by Equation (1).

The equation for the ideal-gas part $\gamma^o$ is identical with Equation (17) except for the values of the two coefficients $n_1^0$ and $n_2^0$, see table given in **5.10.4.1**. For the use of Equation (17) as part of Equation (19) the coefficients $n_1^0$ and $n_2^0$ were slightly readjusted to meet the high consistency requirement between Eqs. (19) and (16) regarding the properties *h* and *s* along the saturated vapour line; given below,

The equation for the residual part $\gamma^r$ peruses:

$$\gamma^r = \sum_{i=1}^{13} n_i \pi^{I_i} (\tau - 0.5)^{J_i} \quad ...(20)$$

Where $\pi = p/p^*$ and $\tau = T^*/T$ with $p^* = 1$ Mpa and $T^* = 540$ K. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (20) are listed in following table:

NOTE — In the metastable-vapour region there are no experimental data to which an equation can be fitted. Thus, Equation (19) is only based on input values extrapolated from the stable single-phase region 2. These extrapolations were performed with a special low-density gas equation [10] considered to be more suitable for such extrapolations into the metastable-vapour region than IAPWS-95 [*see* [3] of Annex C].

All thermodynamic properties can be derived from Equation (19) by using the appropriate combinations of the ideal-gas part $\gamma^o$, Equation (17), and the residual part $\gamma^r$, Equation (20), of the dimensionless Gibbs free energy and their derivatives. Relations between the relevant thermodynamic properties and $\gamma^o$ and $\gamma^r$ and their derivatives are summarized in table.

All required derivatives of the ideal-gas part and of the residual part of the dimensionless Gibbs free energy are explicitly given in the above table and table given below, respectively.

**Numerical Values of the Coefficients and Exponents of the Residual Part $\gamma^r$ of the Dimensionless Gibbs Free Energy for the Metastable-Vapour Region, Equation (20)**

| $i$ | $I_i$ | $J_i$ | $n_i$ | $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 0 | $-0.733\,622\,601\,865\,06 \times 10^{-2}$ | 8 | 3 | 4 | $-0.634\,980\,376\,573\,13 \times 10^{-2}$ |
| 2 | 1 | 2 | $-0.882\,238\,319\,431\,46 \times 10^{-1}$ | 9 | 3 | 16 | $-0.860\,430\,930\,285\,88 \times 10^{-1}$ |
| 3 | 1 | 5 | $-0.723\,345\,552\,132\,45 \times 10^{-1}$ | 10 | 4 | 7 | $0.753\,215\,815\,227\,70 \times 10^{-2}$ |
| 4 | 1 | 11 | $-0.408\,131\,785\,344\,55 \times 10^{-2}$ | 11 | 4 | 10 | $-0.792\,383\,754\,461\,39 \times 10^{-2}$ |
| 5 | 2 | 1 | $0.200\,978\,033\,802\,07 \times 10^{-2}$ | 12 | 5 | 9 | $-0.228\,881\,607\,784\,47 \times 10^{-3}$ |
| 6 | 2 | 7 | $-0.530\,459\,218\,986\,42 \times 10^{-1}$ | 13 | 5 | 10 | $-0.264\,565\,014\,828\,10 \times 10^{-2}$ |
| 7 | 2 | 16 | $-0.761\,904\,090\,869\,70 \times 10^{-2}$ | | | | |

**Residual Part $\gamma^r$ of the Dimensionless Gibbs Free Energy and its Derivatives[a] According to Equation (20)**

| | |
|---|---|
| $\gamma^r = \sum_{i=1}^{13} n_i \pi^{I_i} (\tau - 0.5)^{J_i}$ | |
| $\gamma^r_\pi = \sum_{i=1}^{13} n_i I_i \pi^{I_i - 1} (\tau - 0.5)^{J_i}$ | $\gamma^r_{\pi\pi} = \sum_{i=1}^{13} n_i I_i (I_i - 1) \pi^{I_i - 2} (\tau - 0.5)^{J_i}$ |
| $\gamma^r_\tau = \sum_{i=1}^{13} n_i \pi^{I_i} J_i (\tau - 0.5)^{J_i - 1}$ | $\gamma^r_{\tau\tau} = \sum_{i=1}^{13} n_i \pi^{I_i} J_i (J_i - 1)(\tau - 0.5)^{J_i - 2}$ |
| $\gamma^r_{\pi\tau} = \sum_{i=1}^{13} n_i I_i \pi^{I_i - 1} J_i (\tau - 0.5)^{J_i - 1}$ | |
| [a] $\gamma^r_\pi = \left[\frac{\partial \gamma^r}{\partial \pi}\right]_\tau$, $\gamma^r_{\pi\pi} = \left[\frac{\partial^2 \gamma^r}{\partial \pi^2}\right]_\tau$, $\gamma^r_\tau = \left[\frac{\partial \gamma^r}{\partial \tau}\right]_\pi$, $\gamma^r_{\tau\tau} = \left[\frac{\partial^2 \gamma^r}{\partial \tau^2}\right]_\pi$, $\gamma^r_{\pi\tau} = \left[\frac{\partial^2 \gamma^r}{\partial \pi \partial \tau}\right]$ | |

1) *Range of Validity*

Equation (19) is valid in the metastable-vapour region from the saturated-vapour line to the 5 percent equilibrium moisture line (determined from the equilibrium $h'$ and $h''$ values calculated at the given pressure) for pressures from the triple-point pressure, *see* Equation (9), up to 10 Mpa.

2) *Numerical Consistency with the Basic Equation*

The consistency of Equation (19) with the basic equation, Equation (16), along the saturated vapour line is characterized by the following maximum inconsistencies regarding the properties $v$, $h$, $c_p$, $s$, $g$, and $w$:

$|\Delta v|_{max}$ = 0.014 percent $\quad |\Delta s|_{max}$ = 0.082 J kg$^{-1}$ K$^{-1}$ … (21)

$|\Delta h|_{max}$ = 0.043 *kJ kg*$^{-1}$ $\quad |\Delta g|_{max}$ = 0.023 kJ kg$^{-1}$

$|\Delta c_p|_{max}$ = 0.078 percent $\quad |\Delta w|_{max}$ = 0.051 percent

These maximum inconsistencies are clearly smaller than the consistency requirements on region boundaries corresponding to Prague values *see* [13] of Annex C, which are given in **5.6**.

Along the isobar in the metastable-vapour region, transition between Equation (19) and Equation (16) is not smooth, which is however, not of importance for practical calculations.

**5.10.4.3** *Backward equations*

For the calculation of properties as function of $p$, $h$ or of $p$, $s$ or of $h$, without any iteration, the two backward equations require extremely good numerical consistency with the basic equation. The exact requirements for these numerical consistencies were obtained from comprehensive test calculations for several characteristic power cycles. The result of these investigations, namely the assignment of the tolerable numerical inconsistencies between the basic equation, Equation (16), and the corresponding backward equations, is given in following tables respectively.

Region 2 is covered by three $p$ ($h$, $s$) equations, corresponding to the three $T$ ($p$, $h$) and three $T$ ($p$, $s$) backward equations. The figures shows the way in which region 2 is divided into three sub-regions for the backward equations. The boundary between the sub-regions 2a and 2b is the isobar $p$ = 4 *MPa*; In order to decide which $p$ ($h$, s) equation, 2a or 2b, must be used for given values of $h$ and $s$, the boundary equation $h_{2ab}$ ($s$), Equation (22), has to be used. This equation is a polynomial of the third degree and reads.

$$\frac{h_{2ab}(s)}{h^*} = \eta(\sigma) = n_1 + n_2\sigma + n_3\sigma^2 + n_4\sigma^3 \quad ...(22)$$

where $\eta = h/h^*$ and $\sigma = s/s^*$ with $h^*$=1 kJ kg$^{-1}$ and $s^*$=1 kJ kg$^{-1}$ K$^{-1}$. The coefficients $n_i$ to $n_4$ of Equation (22) are listed in the following table:

**Numerical Values of the Coefficients of the $h_{2ab}(s)$ in its Dimensionless for Equation (22), for Defining the Boundary Between Sub-Regions 2b and 2c**

| $i$ | $n_i$ |
|---|---|
| 1 | – 0.349 898 083 432 139 × 10$^4$ |
| 2 | 0.257 560 716 905 876 × 10$^4$ |
| 3 | – 0.421 073 558 227 969 × 10$^3$ |
| 4 | 0.276 349 063 799 944 × 10$^2$ |

The boundary between the sub-regions 2b and 2c corresponds to the entropy line $s$ = 5.85 kJ kg$^{-1}$ K$^{-1}$. Input points can be tested directly to identify the

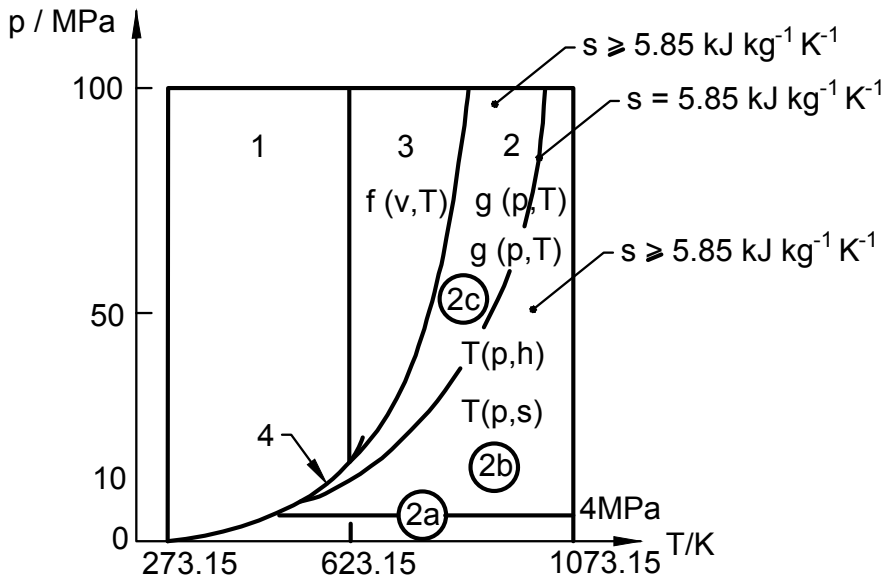



Fig. 5-2 Division of Region 2 into the Three Sub-Region 2a, 2b, and 2c for the Back Ward Equations T(p,s)

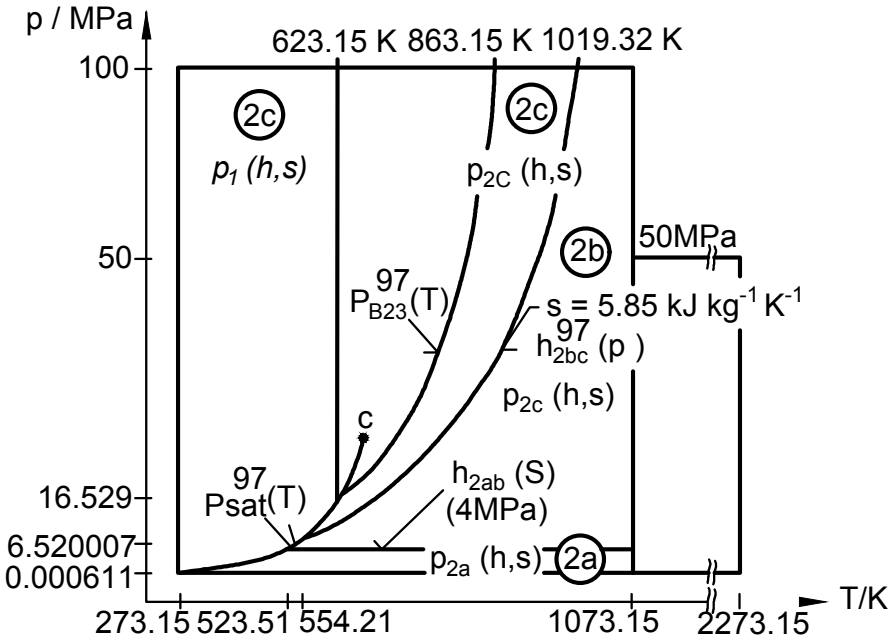



Fig. 5-3 Division of Region 2 into the Three Sub-Region 2a, 2b, and 2c for the Back Ward Equations p(h,s)

sub-region since the specific entropy is an independent variable. In order to know whether the $T(p, h)$ equation for sub-region 2b or for sub-region 2c has to be used for given values of $p$ and $h$, a special correlation equation for the boundary between sub-regions 2b and 2c (which approximates $s$ = 5.85 kJ kg$^{-1}$ K$^{-1}$) is needed; *see* figure. This boundary equation, called the B2bc-equation, is a simple quadratic pressure-enthalpy relation which peruses.

$$\pi = n_1 + n_2\eta + n_3\eta^2 \qquad \ldots (23)$$

where $\pi = p/p^*$ and $\eta = h/h^*$ with $p^*$ = 1 MPa and $h^*$ = 1 kJ kg$^{-1}$. The coefficients $n_1$ to $n_3$ of Equation (23) are listed in the Table given below. Based on its simple form, Equation (23) does not describe exactly the isentropic line s = 5.85 kJ kg$^{-1}$ K$^{-1}$; the entropy values corresponding to this p – h relation are between s = 5.81 kJ kg$^{-1}$ K$^{-1}$ and s = 5.85 kJ kg$^{-1}$ K$^{-1}$. The enthalpy-explicit form of Equation (23) is as follows:

$$\eta = n_4 + [(\pi - n_5)/n_3]^{1/2} \qquad \ldots (24)$$

with $\pi$ and $\eta$ according to Equation (23) and the coefficients $n_3$ to $n_s$ listed in the following table. Equations (23) and (24) give the boundary line between sub-regions 2b and 2c from the saturation state at $T$ =5 54.485 K and $p_s$ = 6.546 70 MPa to $T$ = 101 9.32 K and $p$ = 100 MPa.

For the backward equations $T(p,s)$ the boundary between sub-regions 2b and 2c is, based on the value $s$ = 5.85 kJ kg$^{-1}$ K$^{-1}$ along this boundary, automatically defined for given values of $p$ and $s$.

**Numerical Values of the Coefficients of the B2bc-Equation, Equations (23) and (24), for Defining the Boundary Between Sub-Regions 2b and 2c with Respect to $T(p,h)$ Calculations**

| $i$ | $n_i$ |
|---|---|
| 1 | 0.905 842 785 147 23 × 10$^3$ |
| 2 | – 0.679 557 863 992 41 |
| 3 | 0.128 090 027 301 36 × 10$^{-3}$ |
| 4 | 0.265 265 719 084 28 × 10$^4$ |
| 5 | 0.452 575 789 059 48 × 10$^1$ |

Backward Equations $p(h,s)$ for Sub-regions 2a, 2b and 2c.

The backward equation $p_{2a}(h,s)$ for sub-region 2a in its dimensionless form peruses.

$$\frac{p_{2a}(h,s)}{p^*} = \pi(\eta,\sigma) = \left[\sum_{i=1}^{29} n_i (\eta - 0.5)^{I_i} (\sigma - 1.2)^{J_i}\right]^4 \qquad \ldots (25)$$

Where $\pi = p/p^*$, $\eta = h/h^*$ and $\sigma = s/s^*$ with $p^* = 4$ MPa and $h^*$ = 4200 kJ kg$^{-1}$, and $s^*$ = 12 kJ kg$^{-1}$ K$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (25) are listed in following table:

**Numerical Values of the Coefficients and Exponents of the Backward Equation $p_{2a}(h,s)$ for Sub-Region 2a, Equation (25)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | 0 | 1 | – 0.182 575 361 923 032 × 10$^{-1}$ |
| 2 | 0 | 3 | – 0.125 229 548 799 536 |
| 3 | 0 | 6 | 0.592 290 437 320 145 |
| 4 | 0 | 16 | 0.604 769 706 185 122 × 10$^1$ |
| 5 | 0 | 20 | 0.238 624 965 444 474 × 10$^3$ |
| 6 | 0 | 22 | – 0.298 639 090 222 922 × 10$^3$ |
| 7 | 1 | 0 | 0.512 250 813 040 750 × 10$^1$ |
| 8 | 1 | 1 | – 0.437 266 515 606 486 |
| 9 | 1 | 2 | 0.413 336 902 999 504 |
| 10 | 1 | 3 | – 0.516 468 254 574 773 × 10$^1$ |
| 11 | 1 | 5 | – 0.557 014 838 445 711 × 10$^1$ |
| 12 | 1 | 6 | 0.128 555 037 824 478 × 10$^2$ |
| 13 | 1 | 10 | 0.114 144 108 953 290 × 10$^2$ |
| 14 | 1 | 16 | – 0.119 504 225 652 714 × 10$^3$ |
| 15 | 1 | 20 | – 0.284 777 985 961 560 × 10$^4$ |
| 16 | 1 | 22 | 0.431 757 846 408 006 × 10$^4$ |
| 17 | 2 | 3 | 0.112 894 040 802 650 × 10$^1$ |
| 18 | 2 | 16 | 0.197 409 186 206 319 × 10$^4$ |
| 19 | 2 | 20 | 0.151 612 444 706 087 × 10$^4$ |
| 20 | 3 | 0 | 0.141 324 451 421 235 × 10$^{-1}$ |
| 21 | 3 | 2 | 0.585 501 282 219 601 |
| 22 | 3 | 3 | – 0.297 258 075 863 012 × 10$^1$ |
| 23 | 3 | 6 | 0.594 567 314 847 319 × 10$^1$ |
| 24 | 3 | 16 | – 0.623 656 565 798 905 × 10$^4$ |
| 25 | 4 | 16 | 0.965 986 235 133 332 × 10$^4$ |
| 26 | 5 | 3 | 0.681 500 934 948 134 × 10$^1$ |
| 27 | 5 | 16 | – 0.633 207 286 824 489 × 10$^4$ |
| 28 | 6 | 3 | – 0.558 919 224 465 760 × 10$^1$ |
| 29 | 7 | 1 | 0.400 645 798 472 063 × 10$^{-1}$ |

The backward equation $p_{2b}(h,s)$ for sub-region 2b in its dimensionless form peruses.

$$\frac{p_{2b}(h,s)}{p^*} = \pi(\eta,\sigma) = \left[\sum_{i=1}^{33} n_i (\eta - 0.6)^{I_i} (\sigma - 1.01)^{J_i}\right]^4 \qquad \ldots (26)$$

Where $\pi = p/p^*$, $\eta = h/h^*$ and $\sigma = s/s^*$ with $p^* = 100$ MPa and $h^* = 4100$ kJ kg$^{-1}$, and $s^* = 7.9$ kJ kg$^{-1}$ K$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (26) are listed in following table.

**Numerical Values of the Coefficients and Exponents of the Backward Equation $p_{2b}(h,s)$ for Sub-Region 2b, Equation (26)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | 0 | 0 | $0.801\,496\,989\,929\,495 \times 10^{-1}$ |
| 2 | 0 | 1 | $-0.543\,862\,807\,146\,111$ |
| 3 | 0 | 2 | $0.337\,455\,597\,421\,283$ |
| 4 | 0 | 4 | $0.890\,555\,451\,157\,450 \times 10^{1}$ |
| 5 | 0 | 8 | $0.313\,840\,736\,431\,485 \times 10^{3}$ |
| 6 | 1 | 0 | $0.797\,367\,065\,977\,789$ |
| 7 | 1 | 1 | $-0.121\,616\,973\,556\,240 \times 10^{1}$ |
| 8 | 1 | 2 | $0.872\,803\,386\,937\,477 \times 10^{1}$ |
| 9 | 1 | 3 | $-0.169\,769\,781\,757\,602 \times 10^{2}$ |
| 10 | 1 | 5 | $-0.186\,552\,827\,328\,416 \times 10^{3}$ |
| 11 | 1 | 12 | $0.951\,159\,274\,344\,237 \times 10^{5}$ |
| 12 | 2 | 1 | $-0.189\,168\,510\,120\,494 \times 10^{2}$ |
| 13 | 2 | 6 | $-0.433\,407\,037\,194\,840 \times 10^{4}$ |
| 14 | 2 | 18 | $0.543\,212\,633\,012\,715 \times 10^{9}$ |
| 15 | 3 | 0 | $0.144\,793\,408\,386\,013$ |
| 16 | 3 | 1 | $0.128\,024\,559\,637\,516 \times 10^{3}$ |
| 17 | 3 | 7 | $-0.672\,309\,534\,071\,268 \times 10^{5}$ |
| 18 | 3 | 12 | $0.336\,972\,380\,095\,287 \times 10^{8}$ |
| 19 | 4 | 1 | $-0.586\,634\,196\,762\,720 \times 10^{3}$ |
| 20 | 4 | 16 | $-0.221\,403\,224\,769\,889 \times 10^{11}$ |
| 21 | 5 | 1 | $0.171\,606\,668\,708\,389 \times 10^{4}$ |
| 22 | 5 | 12 | $-0.570\,817\,595\,806\,302 \times 10^{9}$ |
| 23 | 6 | 1 | $-0.312\,109\,693\,178\,482 \times 10^{4}$ |
| 24 | 6 | 8 | $-0.207\,841\,384\,633\,010 \times 10^{7}$ |
| 25 | 6 | 18 | $0.305\,605\,946\,157\,786 \times 10^{13}$ |
| 26 | 7 | 1 | $0.322\,157\,004\,314\,333 \times 10^{4}$ |
| 27 | 7 | 16 | $0.326\,810\,259\,797\,295 \times 10^{12}$ |
| 28 | 8 | 1 | $-0.144\,104\,158\,934\,487 \times 10^{4}$ |
| 29 | 8 | 3 | $0.410\,694\,867\,802\,691 \times 10^{3}$ |
| 30 | 8 | 14 | $0.109\,077\,066\,873\,024 \times 10^{12}$ |
| 31 | 8 | 18 | $-0.247\,964\,654\,258\,893 \times 10^{14}$ |
| 32 | 12 | 10 | $0.188\,801\,906\,865\,134 \times 10^{10}$ |
| 33 | 14 | 16 | $-0.123\,651\,009\,018\,773 \times 10^{15}$ |

The backward equation $p_{2c}(h,s)$ for sub-region 2c in its dimensionless form peruses.

$$\frac{p_{2c}(h,s)}{p^*} = \pi(\eta,\sigma) = \left[\sum_{i=1}^{31} n_i (\eta - 0.7)^{I_i} (\sigma - 1.1)^{J_i}\right]^4 \quad \text{... (27)}$$

Where $\pi = p/p^*$, $\eta = h/h^*$ and $\sigma = s/s^*$ with $p^* = 100$ MPa and $h^* = 3500$ kJ kg$^{-1}$, and $s^* = 5.9$ kJ kg$^{-1}$ K$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (27) are listed in following table.

**Numerical Values of the Coefficients and Exponents of the Backward Equation $p_{2c}(h,s)$ for Sub-Region 2c, Equation (27)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | 0 | 0 | $0.112\,225\,607\,199\,012$ |
| 2 | 0 | 1 | $-0.339\,005\,953\,606\,712 \times 10^{1}$ |
| 3 | 0 | 2 | $-0.320\,503\,911\,730\,094 \times 10^{2}$ |
| 4 | 0 | 3 | $-0.197\,597\,305\,104\,900 \times 10^{3}$ |
| 5 | 0 | 4 | $-0.407\,693\,861\,553\,446 \times 10^{3}$ |
| 6 | 0 | 8 | $0.132\,943\,775\,222\,331 \times 10^{5}$ |
| 7 | 1 | 0 | $0.170\,846\,839\,774\,007 \times 10^{1}$ |
| 8 | 1 | 2 | $0.373\,694\,198\,142\,245 \times 10^{2}$ |
| 9 | 1 | 5 | $0.358\,144\,365\,815\,434 \times 10^{4}$ |
| 10 | 1 | 8 | $0.423\,014\,446\,424\,664 \times 10^{6}$ |
| 11 | 1 | 14 | $-0.751\,071\,025\,760\,063 \times 10^{9}$ |
| 12 | 2 | 2 | $0.523\,446\,127\,607\,898 \times 10^{2}$ |
| 13 | 2 | 3 | $-0.228\,351\,290\,812\,417 \times 10^{3}$ |
| 14 | 2 | 7 | $-0.960\,652\,417\,056\,937 \times 10^{6}$ |
| 15 | 2 | 10 | $-0.807\,059\,292\,526\,074 \times 10^{8}$ |
| 16 | 2 | 18 | $0.162\,698\,017\,225\,669 \times 10^{13}$ |
| 17 | 3 | 0 | $0.772\,465\,073\,604\,171$ |
| 18 | 3 | 5 | $0.463\,929\,973\,837\,746 \times 10^{5}$ |
| 19 | 3 | 8 | $-0.137\,317\,885\,134\,128 \times 10^{8}$ |
| 20 | 3 | 16 | $0.170\,470\,392\,630\,512 \times 10^{13}$ |
| 21 | 3 | 18 | $-0.251\,104\,628\,187\,308 \times 10^{14}$ |
| 22 | 4 | 18 | $0.317\,748\,830\,835\,520 \times 10^{14}$ |
| 23 | 5 | 1 | $0.538\,685\,623\,675\,312 \times 10^{2}$ |
| 24 | 5 | 4 | $-0.553\,089\,094\,625\,169 \times 10^{5}$ |
| 25 | 5 | 6 | $-0.102\,861\,522\,421\,405 \times 10^{7}$ |
| 26 | 5 | 14 | $0.204\,249\,418\,756\,234 \times 10^{13}$ |
| 27 | 6 | 8 | $0.273\,918\,446\,626\,977 \times 10^{9}$ |
| 28 | 6 | 18 | $-0.263\,963\,146\,312\,685 \times 10^{16}$ |
| 29 | 10 | 7 | $-0.107\,890\,854\,108\,088 \times 10^{10}$ |
| 30 | 12 | 7 | $-0.296\,492\,620\,980\,124 \times 10^{11}$ |
| 31 | 16 | 10 | $-0.111\,754\,907\,323\,424 \times 10^{16}$ |

1) *Numerical Consistency with the Basic Equation*

The maximum percentage deviations for pressure and related root-mean-square values of the Equations (25), (26) and (27) from basic equation $g_2(p,T)$ in comparison with the permissible differences are listed in following table.

**Maximum Differences $|\Delta p/p|_{max}$ and Root-Mean-Square Differences $|\Delta p/p|_{RMS}$ Between Pressures Calculated from Equations (25) to (27), and from basic Equation in $g_2$ $(p,T)$ in Comparison with the Tolerated Differences $|\Delta p/p|_{tol}$**

| *Sub-region* | *Equation* | $\lvert\Delta p/p\rvert_{tol}$ | $\lvert\Delta p/p\rvert_{max}$ | $\lvert\Delta p/p\rvert_{RMS}$ |
|---|---|---|---|---|
| 2a | 25 | 0.0035 % | 0.0029 % | 0.0013 % |
| 2b | 26 | 0.0035 % | 0.0034 % | 0.0005 % |
| 2c | 27 | 0.0088 % | 0.0063 % | 0.0010 % |

Backward Equations $T(p,h)$ for Sub-regions 2a, 2b and 2c.

The backward equation $T(p,h)$ for sub-region 2a in its dimensionless form peruses.

$$\frac{T_{2a}(p,h)}{T^*} = \theta_{2a}(\pi,\eta) = \sum_{i=1}^{34} n_i \pi^{I_i} (\eta - 2.1)^{J_i} \quad ...(28)$$

Where $\theta = T/T^*$, $\pi = p/p^*$ and $\eta = h/h^*$ with $p^* = 1$ MPa and $h^* = 2000$ kJ kg$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Eq. (28) are listed in following table:

**Numerical Values of the Coefficients and Exponents of the Backward Equation *T*(*p, h*) for Sub-Region 2a, Equation (28)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | 0 | 0 | $0.108\,989\,523\,182\,88 \times 10^4$ |
| 2 | 0 | 1 | $0.849\,516\,544\,955\,35 \times 10^3$ |
| 3 | 0 | 2 | $-0.107\,817\,480\,918\,26 \times 10^3$ |
| 4 | 0 | 3 | $0.331\,536\,548\,012\,63 \times 10^2$ |
| 5 | 0 | 7 | $-0.742\,320\,167\,902\,48 \times 10^1$ |
| 6 | 0 | 20 | $0.117\,650\,487\,243\,56 \times 10^2$ |
| 7 | 1 | 0 | $0.184\,457\,493\,557\,90 \times 10^1$ |
| 8 | 1 | 1 | $-0.417\,927\,005\,496\,24 \times 10^1$ |
| 9 | 1 | 2 | $0.624\,781\,969\,358\,12 \times 10^1$ |
| 10 | 1 | 3 | $-0.173\,445\,631\,081\,14 \times 10^2$ |
| 11 | 1 | 7 | $-0.200\,581\,768\,620\,96 \times 10^3$ |
| 12 | 1 | 9 | $0.271\,960\,654\,737\,96 \times 10^3$ |
| 13 | 1 | 11 | $-0.455\,113\,182\,858\,18 \times 10^3$ |
| 14 | 1 | 18 | $0.309\,196\,886\,047\,55 \times 10^4$ |
| 15 | 1 | 44 | $0.252\,266\,403\,578\,72 \times 10^6$ |
| 16 | 2 | 0 | $-0.617\,074\,228\,683\,39 \times 10^{-2}$ |
| 17 | 2 | 2 | $-0.310\,780\,466\,295\,83$ |
| 18 | 2 | 7 | $0.116\,708\,730\,771\,07 \times 10^2$ |
| 19 | 2 | 36 | $0.128\,127\,984\,040\,46 \times 10^9$ |
| 20 | 2 | 38 | $-0.985\,549\,096\,232\,76 \times 10^9$ |
| 21 | 2 | 40 | $0.282\,245\,469\,730\,02 \times 10^{10}$ |
| 22 | 2 | 42 | $-0.359\,489\,714\,107\,03 \times 10^{10}$ |
| 23 | 2 | 44 | $0.172\,273\,499\,131\,97 \times 10^{10}$ |
| 24 | 3 | 24 | $-0.135\,513\,342\,407\,75 \times 10^5$ |
| 25 | 3 | 44 | $0.128\,487\,346\,646\,50 \times 10^8$ |
| 26 | 4 | 12 | $0.138\,657\,242\,832\,26 \times 10^1$ |
| 27 | 4 | 32 | $0.235\,988\,325\,565\,14 \times 10^6$ |
| 28 | 4 | 44 | $-0.131\,052\,365\,450\,54 \times 10^8$ |
| 29 | 5 | 32 | $0.739\,998\,354\,747\,66 \times 10^4$ |
| 30 | 5 | 36 | $-0.551\,966\,970\,300\,60 \times 10^6$ |
| 31 | 5 | 42 | $0.371\,540\,859\,962\,33 \times 10^7$ |
| 32 | 6 | 34 | $0.191\,277\,292\,396\,60 \times 10^5$ |
| 33 | 6 | 44 | $-0.415\,351\,648\,356\,34 \times 10^6$ |
| 34 | 7 | 28 | $-0.624\,598\,551\,925\,07 \times 10^2$ |

The backward equation $T(p,h)$ for sub-region 2b in its dimensionless form peruses

$$\frac{T_{2b}(p,h)}{T^*} = \theta_{2b}(\pi,\eta) = \sum_{i=1}^{38} n_i (\pi - 2)^{I_i} (\eta - 2.6)^{J_i} \quad ...(29)$$

where $\theta = T/T^*$, $\pi = p/p^*$ and $\eta = h/h^*$ with $T^* = 1$ K, $p^* = 1$ MPa and $h^* = 2000$ kJ kg$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (29) are listed in following table:

**Numerical Values of the Coefficients and Exponents of the Backward Equation *T*(*p, h*) for Sub-Region 2b, Equation (29)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | 0 | 0 | $0.148\,950\,410\,795\,16 \times 10^4$ |
| 2 | 0 | 1 | $0.743\,077\,983\,140\,34 \times 10^3$ |
| 3 | 0 | 2 | $-0.977\,083\,187\,978\,37 \times 10^2$ |
| 4 | 0 | 12 | $0.247\,424\,647\,056\,74 \times 10^1$ |
| 5 | 0 | 18 | $-0.632\,813\,200\,160\,26$ |
| 6 | 0 | 24 | $0.113\,859\,521\,296\,58 \times 10^1$ |
| 7 | 0 | 28 | $-0.478\,118\,636\,486\,25$ |
| 8 | 0 | 40 | $0.852\,081\,234\,315\,44 \times 10^{-2}$ |
| 9 | 1 | 0 | $0.937\,471\,473\,779\,32$ |

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 10 | 1 | 2 | $0.335\,931\,186\,049\,16 \times 10^{1}$ |
| 11 | 1 | 6 | $0.338\,093\,556\,014\,54 \times 10^{1}$ |
| 12 | 1 | 12 | 0.168 445 396 719 04 |
| 13 | 1 | 18 | 0.738 757 452 366 95 |
| 14 | 1 | 24 | – 0.471 287 374 361 86 |
| 15 | 1 | 28 | 0.150 202 731 397 07 |
| 16 | 1 | 40 | $-0.217\,641\,142\,197\,50 \times 10^{-2}$ |
| 17 | 2 | 2 | $-0.218\,107\,553\,247\,61 \times 10^{-1}$ |
| 18 | 2 | 8 | – 0.108 297 844 036 77 |
| 19 | 2 | 18 | $-0.463\,333\,246\,358\,12 \times 10^{-1}$ |
| 20 | 2 | 40 | $0.712\,803\,519\,595\,51 \times 10^{-4}$ |
| 21 | 3 | 1 | $0.110\,328\,317\,899\,99 \times 10^{-3}$ |
| 22 | 3 | 2 | $0.189\,552\,483\,879\,02 \times 10^{-3}$ |
| 23 | 3 | 12 | $0.308\,915\,411\,605\,37 \times 10^{-2}$ |
| 24 | 3 | 24 | $0.135\,555\,045\,549\,49 \times 10^{-2}$ |
| 25 | 4 | 2 | $0.286\,402\,374\,774\,56 \times 10^{-6}$ |
| 26 | 4 | 12 | $-0.107\,798\,573\,575\,12 \times 10^{-4}$ |
| 27 | 4 | 18 | $-0.764\,627\,124\,548\,14 \times 10^{-4}$ |
| 28 | 4 | 24 | $0.140\,523\,928\,183\,16 \times 10^{-4}$ |
| 29 | 4 | 28 | $-0.310\,838\,143\,314\,34 \times 10^{-4}$ |
| 30 | 4 | 40 | $-0.103\,027\,382\,121\,03 \times 10^{-5}$ |
| 31 | 5 | 18 | $0.282\,172\,816\,350\,40 \times 10^{-6}$ |
| 32 | 5 | 24 | $0.127\,049\,022\,719\,45 \times 10^{-5}$ |
| 33 | 5 | 40 | $0.738\,033\,534\,682\,92 \times 10^{-7}$ |
| 34 | 6 | 28 | $-0.110\,301\,392\,389\,09 \times 10^{-7}$ |
| 35 | 7 | 2 | $-0.814\,563\,652\,078\,33 \times 10^{-13}$ |
| 36 | 7 | 28 | $-0.251\,805\,456\,829\,62 \times 10^{-10}$ |
| 37 | 9 | 1 | $-0.175\,652\,339\,694\,07 \times 10^{-17}$ |
| 38 | 9 | 40 | $0.869\,341\,563\,441\,63 \times 10^{-14}$ |

The backward equation $T(p,h)$ for sub-region 2c in its dimensionless form peruses.

$$\frac{T_{2c}(p,h)}{T^*} = \theta_{2c}(\pi,\eta) = \sum_{i=1}^{23} n_i (\pi + 25)^{I_i} (\eta - 1.8)^{J_i} \quad ...(30)$$

where $\theta = T/T^*$, $\pi = p/p^*$ and $\eta = h/h^*$ with $T^* = 1$ K, $p^* = 1$ MPa and $h^* = 2000$ kJ kg$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (30) are listed in following table:

**Numerical Values of the Coefficients and Exponents of the Backward Equation *T*(*p, h*) for Sub-Region 2c, Equation (30)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –7 | 0 | $-0.323\,683\,985\,552\,42 \times 10^{13}$ |
| 2 | –7 | 4 | $0.732\,633\,509\,021\,81 \times 10^{13}$ |
| 3 | –6 | 0 | $0.358\,250\,899\,454\,47 \times 10^{12}$ |
| 4 | –6 | 2 | $-0.583\,401\,318\,515\,90 \times 10^{12}$ |
| 5 | –5 | 0 | $-0.107\,830\,682\,174\,70 \times 10^{11}$ |
| 6 | –5 | 2 | $0.208\,255\,445\,631\,71 \times 10^{11}$ |
| 7 | –2 | 0 | $0.610\,747\,835\,645\,16 \times 10^{6}$ |
| 8 | –2 | 1 | $0.859\,777\,225\,355\,80 \times 10^{6}$ |
| 9 | –1 | 0 | $-0.257\,457\,236\,041\,70 \times 10^{5}$ |
| 10 | –1 | 2 | $0.310\,810\,884\,227\,14 \times 10^{5}$ |
| 11 | 0 | 0 | $0.120\,823\,158\,659\,36 \times 10^{4}$ |
| 12 | 0 | 1 | $0.482\,197\,551\,092\,55 \times 10^{3}$ |
| 13 | 1 | 4 | $0.379\,660\,012\,724\,86 \times 10^{1}$ |
| 14 | 1 | 8 | $-0.108\,429\,848\,800\,77 \times 10^{2}$ |
| 15 | 2 | 4 | $-0.453\,641\,726\,766\,60 \times 10^{-1}$ |
| 16 | 6 | 0 | $0.145\,591\,156\,586\,98 \times 10^{-12}$ |
| 17 | 6 | 1 | $0.112\,615\,974\,072\,30 \times 10^{-11}$ |
| 18 | 6 | 4 | $-0.178\,049\,822\,406\,86 \times 10^{-10}$ |
| 19 | 6 | 10 | $0.123\,245\,796\,908\,32 \times 10^{-6}$ |
| 20 | 6 | 12 | $-0.116\,069\,211\,309\,84 \times 10^{-5}$ |
| 21 | 6 | 16 | $0.278\,463\,670\,885\,54 \times 10^{-4}$ |
| 22 | 6 | 20 | $-0.592\,700\,384\,741\,76 \times 10^{-3}$ |
| 23 | 6 | 22 | $0.129\,185\,829\,918\,78 \times 10^{-2}$ |

1) *Range of Validity*

Equations (28), (29), and (30) are only valid in the respective sub-region 2a, 2b, and 2c which do not include the metastable-vapour region. The boundaries between these sub-regions are defined at the beginning of **5.10.4.3**; the lowest pressure for which Equation (28) is valid amounts to 611.2 127 *Pa* corresponding to the saturation pressure at 273.15 K calculated from Equations (52).

2) *Numerical Consistency with the Basic Equation*

For ten million random pairs of $p$ and $h$ covering each of the sub-regions 2a, 2b, and 2c, the differences

$\Delta T$ between temperatures calculated from Equations (28) to (30), respectively, and from Equation (16) were determined. The corresponding maximum and root-mean-square differences are listed in following Table together with the tolerated differences according to the numerical consistency requirements with respect to Equation (16).

**Maximum Differences $|\Delta T|_{max}$ and Root-Mean-Square Differences $\Delta T_{RMS}$ Between Temperatures Calculated from Equations. (28) to (30), and from Equation (16) in Comparison with the Tolerated Differences $|\Delta T|_{tol}$**

| *Sub-region* | *Equation* | $\|\Delta T\|_{tol}/mK$ | $\|\Delta T\|_{max}/mK$ | $\|\Delta T\|_{RMS}/mK$ |
|---|---|---|---|---|
| 2a | 28 | 10 | 9.3 | 2.9 |
| 2b | 29 | 10 | 9.6 | 3.9 |
| 2c | 30 | 25 | 23.7 | 10.4 |

Backward Equations $T(p,s)$ for Sub-regions 2a, 2b and 2c.

The backward equation $T(p,s)$ for sub-region 2a in its dimensionless form peruses.

$$\frac{T_{2a}(p,s)}{T^*} = \theta_{2a}(\pi,\sigma) = \sum_{i=1}^{46} n_i \pi^{I_i} (\sigma - 2)^{J_i} \quad ...(31)$$

where $\theta = T/T^*$, $\pi = p/p^*$ and $\sigma = s/s^*$ with $T^* = 1$ K, $p^* = 1$ MPa and $s^* = 2$ kJ kg$^{-1}$ K$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (31) are listed in following table.

**Numerical Values of the Coefficients and Exponents of the Backward Equation $T(p, s)$ for Sub-Region 2a, Equation (31)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | −1.5 | −24 | − 0.392 359 838 619 84 × $10^6$ |
| 2 | −1.5 | −23 | 0.515 265 738 272 70 × $10^6$ |
| 3 | −1.5 | −19 | 0.404 824 431 610 48 × $10^5$ |
| 4 | −1.5 | −13 | − 0.321 937 909 239 02 × $10^3$ |
| 5 | −1.5 | −11 | 0.969 614 242 186 94 × $10^2$ |
| 6 | −1.5 | −10 | − 0.228 678 463 717 73 × $10^2$ |
| 7 | −1.25 | −19 | − 0.449 429 141 243 57 × $10^6$ |
| 8 | −1.25 | −15 | − 0.501 183 360 201 66 × $10^4$ |
| 9 | −1.25 | −6 | 0.356 844 635 600 15 |
| 10 | −1.0 | −26 | 0.442 353 358 481 90 × $10^5$ |
| 11 | −1.0 | −21 | − 0.136 733 888 117 08 × $10^5$ |
| 12 | −1.0 | −17 | 0.421 632 602 078 64 × $10^6$ |
| 13 | −1.0 | −16 | 0.225 169 258 374 75 × $10^5$ |
| 14 | −1.0 | −9 | 0.474 421 448 656 46 × $10^3$ |
| 15 | −1.0 | −8 | − 0.149 311 307 976 47 × $10^3$ |
| 16 | −0.75 | −15 | − 0.197 811 263 204 52 × $10^6$ |
| 17 | −0.75 | −14 | − 0.235 543 994 707 60 × $10^5$ |
| 18 | −0.5 | −26 | − 0.190 706 163 020 76 × $10^5$ |
| 19 | −0.5 | −13 | 0.553 756 698 831 64 × $10^5$ |
| 20 | −0.5 | −9 | 0.382 936 914 373 63 × $10^4$ |
| 21 | −0.5 | −7 | − 0.603 918 605 805 67 × $10^3$ |
| 22 | −0.25 | −27 | 0.193 631 026 203 31 × $10^4$ |
| 23 | −0.25 | −25 | 0.426 606 436 986 10 × $10^4$ |
| 24 | −0.25 | −11 | − 0.597 806 388 727 18 × $10^4$ |
| 25 | −0.25 | −6 | − 0.704 014 639 268 62 × $10^3$ |
| 26 | 0.25 | 1 | 0.338 367 841 075 53 × $10^3$ |
| 27 | 0.25 | 4 | 0.208 627 866 351 87 × $10^2$ |
| 28 | 0.25 | 8 | 0.338 341 726 561 96 × $10^{-1}$ |
| 29 | 0.25 | 11 | − 0.431 244 284 148 93 × $10^{-4}$ |
| 30 | 0.5 | 0 | 0.166 537 913 564 12 × $10^3$ |
| 31 | 0.5 | 1 | − 0.139 862 920 558 98 × $10^3$ |
| 32 | 0.5 | 5 | − 0.788 495 479 998 72 |
| 33 | 0.5 | 6 | 0.721 324 117 538 72 × $10^{-1}$ |
| 34 | 0.5 | 10 | − 0.597 548 393 982 83 × $10^{-2}$ |
| 35 | 0.5 | 14 | − 0.121 413 589 539 04 × $10^{-4}$ |
| 36 | 0.5 | 16 | 0.232 270 967 338 71 × $10^{-6}$ |
| 37 | 0.75 | 0 | − 0.105 384 635 661 94 × $10^2$ |
| 38 | 0.75 | 4 | 0.207 189 254 965 02 × $10^1$ |
| 39 | 0.75 | 9 | − 0.721 931 552 604 27 × $10^{-1}$ |
| 40 | 0.75 | 17 | 0.207 498 870 811 20 × $10^{-6}$ |
| 41 | 1.0 | 7 | − 0.183 406 579 113 79 × $10^{-1}$ |
| 42 | 1.0 | 18 | 0.290 362 723 486 96 × $10^{-6}$ |
| 43 | 1.25 | 3 | 0.210 375 278 936 19 |
| 44 | 1.25 | 15 | 0.256 812 397 299 99 × $10^{-3}$ |
| 45 | 1.5 | 5 | − 0.127 990 029 337 81 × $10^{-1}$ |
| 46 | 1.5 | 18 | − 0.821 981 026 520 18 × $10^{-5}$ |

The backward equation $T(p,s)$ for sub-region 2b in its dimensionless form peruses.

$$\frac{T_{2b}(p,s)}{T^*} = \theta_{2b}(\pi,\sigma) = \sum_{i=1}^{44} n_i \pi^{I_i} (10-\sigma)^{J_i} \quad ...(32)$$

where $\theta = T/T^*$, $\pi = p/p^*$ and $\sigma = s/s^*$ with $T^* = 1$ K, $p^* = 1$ MPa and $s^* = 0.7853$ kJ kg$^{-1}$ K$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (32) are listed in following table:

**Numerical Values of the Coefficients and Exponents of the Backward Equation *T*(*p*, *s*) for Sub-Region 2b, Equation (32)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | −6 | 0 | 0.316 876 650 834 97 × 10$^{6}$ |
| 2 | −6 | 11 | 0.208 641 758 818 58 × 10$^{2}$ |
| 3 | −5 | 0 | – 0.398 593 998 035 99 × 10$^{6}$ |
| 4 | −5 | 11 | – 0.218 160 585 188 77 × 10$^{2}$ |
| 5 | −4 | 0 | 0.223 697 851 942 42 × 10$^{6}$ |
| 6 | −4 | 1 | – 0.278 417 034 458 17 × 10$^{4}$ |
| 7 | −4 | 11 | 0.992 074 360 714 80 × 10$^{1}$ |
| 8 | −3 | 0 | – 0.751 975 122 991 57 × 10$^{5}$ |
| 9 | −3 | 1 | 0.297 086 059 511 58 × 10$^{4}$ |
| 10 | −3 | 11 | – 0.344 068 785 485 26 × 10$^{1}$ |
| 11 | −3 | 12 | 0.388 155 642 491 15 |
| 12 | −2 | 0 | 0.175 112 950 857 50 × 10$^{5}$ |
| 13 | −2 | 1 | – 0.142 371 128 544 49 × 10$^{4}$ |
| 14 | −2 | 6 | 0.109 438 033 641 67 × 10$^{1}$ |
| 15 | −2 | 10 | 0.899 716 193 084 95 |
| 16 | −1 | 0 | – 0.337 597 400 989 58 × 10$^{4}$ |
| 17 | −1 | 1 | 0.471 628 858 183 55 × 10$^{3}$ |
| 18 | −1 | 5 | – 0.191 882 419 936 79 × 10$^{1}$ |
| 19 | −1 | 8 | 0.410 785 804 921 96 |
| 20 | −1 | 9 | – 0.334 653 781 720 97 |
| 21 | 0 | 0 | 0.138 700 347 775 05 × 10$^{4}$ |
| 22 | 0 | 1 | – 0.406 633 261 958 38 × 10$^{3}$ |
| 23 | 0 | 2 | 0.417 273 471 596 10 × 10$^{2}$ |
| 24 | 0 | 4 | 0.219 325 494 345 32 × 10$^{1}$ |
| 25 | 0 | 5 | – 0.103 200 500 090 77 × 10$^{1}$ |
| 26 | 0 | 6 | 0.358 829 435 167 03 |
| 27 | 0 | 9 | 0.525 114 537 260 66 × 10$^{-2}$ |
| 28 | 1 | 0 | 0.128 389 164 507 05 × 10$^{2}$ |
| 29 | 1 | 1 | – 0.286 424 372 193 81 × 10$^{1}$ |
| 30 | 1 | 2 | 0.569 126 836 648 55 |
| 31 | 1 | 3 | – 0.999 629 545 849 31 × 10$^{-1}$ |
| 32 | 1 | 7 | – 0.326 320 377 784 59 × 10$^{-2}$ |
| 33 | 1 | 8 | 0.233 209 225 767 23 × 10$^{-3}$ |
| 34 | 2 | 0 | – 0.153 348 098 574 50 |
| 35 | 2 | 1 | 0.290 722 882 399 02 × 10$^{-1}$ |
| 36 | 2 | 5 | 0.375 347 027 411 67 × 10$^{-3}$ |
| 37 | 3 | 0 | 0.172 966 917 024 11 × 10$^{-2}$ |
| 38 | 3 | 1 | – 0.385 560 508 445 04 × 10$^{-3}$ |
| 39 | 3 | 3 | – 0.350 177 122 926 08 × 10$^{-4}$ |
| 40 | 4 | 0 | – 0.145 663 936 314 92 × 10$^{-4}$ |
| 41 | 4 | 1 | 0.564 208 572 672 69 × 10$^{-5}$ |
| 42 | 5 | 0 | 0.412 861 500 746 05 × 10$^{-7}$ |
| 43 | 5 | 1 | – 0.206 846 711 188 24 × 10$^{-7}$ |
| 44 | 5 | 2 | 0.164 093 936 747 25 × 10$^{-8}$ |

The backward equation $T(p,s)$ for sub-region 2c in its dimensionless form peruses.

$$\frac{T_{2c}(p,s)}{T^*} = \theta_{2c}(\pi,\sigma) = \sum_{i=1}^{30} n_i \pi^{I_i} (2-\sigma)^{J_i} \quad ...(33)$$

where $\theta = T/T^*$, $\pi = p/p^*$ and $\sigma = s/s^*$ with $T^* = 1$ K, $p^* = 1$ MPa and $s^* = 2.9251$ kJ kg$^{-1}$ K$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (33) are listed in following table:

**Numerical Values of the Coefficients and Exponents of the Backward Equation *T*(*p*, *s*) for Sub-Region 2c, Equation (33)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | −2 | 0 | 0.909 685 010 053 65 × 10$^{3}$ |
| 2 | −2 | 1 | 0.240 456 670 884 20 × 10$^{4}$ |
| 3 | −1 | 0 | – 0.591 623 263 871 30 × 10$^{3}$ |
| 4 | 0 | 0 | 0.541 454 041 280 74 × 10$^{3}$ |
| 5 | 0 | 1 | – 0.270 983 084 111 92 × 10$^{3}$ |
| 6 | 0 | 2 | 0.979 765 250 979 26 × 10$^{3}$ |
| 7 | 0 | 3 | – 0.469 667 729 594 35 × 10$^{3}$ |
| 8 | 1 | 0 | 0.143 992 746 047 23 × 10$^{2}$ |
| 9 | 1 | 1 | – 0.191 042 042 304 29 × 10$^{2}$ |
| 10 | 1 | 3 | 0.532 991 671 119 71 × 10$^{1}$ |
| 11 | 1 | 4 | – 0.212 529 753 759 34 × 10$^{2}$ |
| 12 | 2 | 0 | – 0.311 473 344 137 60 |
| 13 | 2 | 1 | 0.603 348 408 946 23 |
| 14 | 2 | 2 | – 0.427 648 397 025 09 × 10$^{-1}$ |
| 15 | 3 | 0 | 0.581 855 972 552 59 × 10$^{-2}$ |
| 16 | 3 | 1 | – 0.145 970 082 847 53 × 10$^{-1}$ |
| 17 | 3 | 5 | 0.566 311 756 310 27 × 10$^{-2}$ |
| 18 | 4 | 0 | – 0.761 558 645 845 77 × 10$^{-4}$ |
| 19 | 4 | 1 | 0.224 403 429 193 32 × 10$^{-3}$ |

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 20 | 4 | 4 | – 0.125 610 950 134 13 × $10^{-4}$ |
| 21 | 5 | 0 | 0.633 231 326 609 34 × $10^{-6}$ |
| 22 | 5 | 1 | – 0.205 419 896 753 75 × $10^{-5}$ |
| 23 | 5 | 2 | 0.364 053 703 900 82 × $10^{-7}$ |
| 24 | 6 | 0 | – 0.297 598 977 892 15 × $10^{-8}$ |
| 25 | 6 | 1 | 0.101 366 185 297 63 × $10^{-7}$ |
| 26 | 7 | 0 | 0.599 257 196 923 51 × $10^{-11}$ |
| 27 | 7 | 1 | – 0.206 778 701 051 64 × $10^{-10}$ |
| 28 | 7 | 3 | – 0.208 742 781 818 86 × $10^{-10}$ |
| 29 | 7 | 4 | 0.101 621 668 250 89 × $10^{-9}$ |
| 30 | 7 | 5 | – 0.164 298 282 813 47 × $10^{-9}$ |

1) *Range of Validity*

Equations (31), (32), and (33) are only valid in the respective sub-region 2a, 2b, and 2c which do not include the metastable-vapour region. The boundaries between these sub-regions are defined at the beginning of sub clause **5.10.4.3**; the lowest pressure for which Equation (31) is valid amounts to corresponding to the sublimation pressure [*see* [9] of Annex C] at 273.15 K.

2) *Numerical Consistency with the Basic Equation*

For ten million random pairs of $p$ and $h$ covering each of the sub-regions 2a, 2b, and 2c, the differences between temperatures calculated from Equations (31) to (33), respectively, and from Eq. (16) were determined. The corresponding maximum and root-mean-square differences are listed in following Table together with the tolerated differences according to the numerical consistency requirements with respect to Equation (16):

**Maximum Differences $|\Delta T|_{max}$ and Root-Mean-Square Differences $\Delta T_{RMS}$ Between Temperatures Calculated from Equations (31) to (33), and from Equation (16) in Comparison with the Tolerated Differences $|\Delta T|_{tol}$**

| *Sub-region* | *Equation* | $\lvert\Delta T\rvert_{tol}$/ *mK* | $\lvert\Delta T\rvert_{max}$/ *mK* | $\lvert\Delta T\rvert_{RMS}$/ *mK* |
|---|---|---|---|---|
| 2a | 31 | 10 | 8.8 | 1.2 |
| 2b | 32 | 10 | 6.5 | 2.8 |
| 2c | 33 | 25 | 19.0 | 8.3 |

**5.10.4.4** *Backward functions for regions 1 and 2*

The $p(h,s)$ equations described in sub clause **5.10.3.2** and **5.10.4.3** together with the backward equations $T(p,h)$ of IAPWS-IF97 make it possible to determine $T$ from $h$ and $s$ without iteration.

Liquid region 1

The backward equation For calculating the temperature T from given specific enthalpy h and entropy s for region 1, the following steps should be made: first, the pressure p is calculated using the equation $p_1$ (h,s), and second, the temperature T can be calculated using the equation $T_1$ (p,h), where p is the pressure previously calculated.

Vapour region 2

The calculations of the backward function $T_2$ $(h,s)$ for the entire vapour region 2 should be made as follows: First, using the equation $h_{2ab}(s)$, and the entropy line $s$ =5.85 kJ $kg^{-1}$ $K^{-1}$, search to identify the subregion (2a, 2b or 2c) for the given values of $h$ and $s$. Then, the pressure $p$ for the sub region can be calculated using the equations $p_{2a}$ $(h,s)$ or $p_{2b}$ $(h,s)$ or $p_{2c}$ $(h,s)$. Second, using the equation $h_{2ab}(p)$ and pressure line $p$ = 4 MPa, search to identify the sub region (2a, 2b or 2c) for the given value of $h$ and the calculated value of $p$. Then, the temperature $T$ can be calculated for the sub region using the backward equations $T_{2a}$ $(p,h)$ or $T_{2b}$ $(p,h)$ or $T_{2c}$ $(p,h)$.

1) *Numerical Consistency with the Basic Equation*

The maximum temperature differences and related root-mean-square values between the calculated temperature and the basic equations $g_1$ $(p,T)$ and $g_2$ $(p,T)$ of regions 1 and 2 in comparison with the permissible differences are listed in following table. The temperature differences were calculated using the equation $\Delta T_1 = (T(p(h,s),h) - T)$ for region 1 and $\Delta T_{2a} = (T(p_{2a}(h,s),h) - T)$ for subregion 2a and analogous relations for sub regions 2b and 2c. The function $T$ represents the calculation of $T(p,h)$ using the backward equations of region 2 including the determination in which sub region (2a, 2b, or 2c) the point is located.

**Maximum Differences and Doot-Mean-Square Differences Between Calculated Temperatures and Basic Equations $g_1$ $(p,T)$ and $g_2$ $(p,T)$ in Comparison to the Permissible Differences**

| *Region/Sub region* | $\lvert\Delta T\rvert_{tol}$ | $\lvert\Delta T\rvert_{max}$ | $\lvert\Delta T\rvert_{RMS}$ |
|---|---|---|---|
| 1 | 25 mK | 24.0 mK | 13.4 mK |
| 2*a* | 10 mK | 9.7 mK | 3.0 mK |
| 2*b* | 10 mK | 9.8 mK | 4.0 mK |
| 2*c* | 25 mK | 24.9 mK | 10.3 mK |

**5.10.5** *Equations for Region 3*

This section contains all details relevant for the use of the basic equation of region 3 of IAPWS-IF97. Data about the consistency of the basic equation of this region with the basic equations of regions 1, 2, and 4 along with the related region boundaries is abridged in **5.6**. The auxiliary equation for defining the boundary between regions 2 and 3 is given in **5.10.2**. The evaluation of uncertainty of the most significant properties can be found in **5.7**.

**5.10.5.1** *Basic equation*

The basic equation for this region is a fundamental equation for the specific Helmholtz free energy *f*. This equation is expressed in dimensionless form, $\varphi = f/(RT)$, and peruses

$$\frac{f_3(\rho,T)}{RT} = \varphi(\delta,\tau) = n_1 \ln\delta + \sum_{i=2}^{40} n_i \delta^{I_i} \tau^{J_i} \quad ...(34)$$

where $\delta = p/p^*$, $\tau = T/T^*$ with $\rho^* = \rho_c$, $T^* = T_c$ and $R$, $T_c$, and $\rho_c$ given by Equations (1), (2) and (4). The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (34) are listed in following table:

**Numerical Values of the Coefficients and Exponents of the Dimensionless Helmholtz free Energy for Region 3, Equation (34)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | – | – | $0.106\,580\,700\,285\,13 \times 10^{1}$ |
| 2 | 0 | 0 | $-0.157\,328\,452\,902\,39 \times 10^{2}$ |
| 3 | 0 | 1 | $0.209\,443\,969\,743\,07 \times 10^{2}$ |
| 4 | 0 | 2 | $-0.768\,677\,078\,787\,16 \times 10^{1}$ |
| 5 | 0 | 7 | $0.261\,859\,477\,879\,54 \times 10^{1}$ |
| 6 | 0 | 10 | $-0.280\,807\,811\,486\,20 \times 10^{1}$ |
| 7 | 0 | 12 | $0.120\,533\,696\,965\,17 \times 10^{1}$ |
| 8 | 0 | 23 | $-0.845\,668\,128\,125\,02 \times 10^{-2}$ |
| 9 | 1 | 2 | $-0.126\,543\,154\,777\,14 \times 10^{1}$ |
| 10 | 1 | 6 | $-0.115\,244\,078\,066\,81 \times 10^{1}$ |
| 11 | 1 | 15 | $0.885\,210\,439\,843\,18$ |
| 12 | 1 | 17 | $-0.642\,077\,651\,816\,07$ |
| 13 | 2 | 0 | $0.384\,934\,601\,866\,71$ |
| 14 | 2 | 2 | $-0.852\,147\,088\,242\,06$ |
| 15 | 2 | 6 | $0.489\,722\,815\,418\,77 \times 10^{1}$ |
| 16 | 2 | 7 | $-0.305\,026\,172\,569\,65 \times 10^{1}$ |
| 17 | 2 | 22 | $0.394\,205\,368\,791\,54 \times 10^{-1}$ |
| 18 | 2 | 26 | $0.125\,584\,084\,243\,08$ |
| 19 | 3 | 0 | $-0.279\,993\,296\,987\,10$ |
| 20 | 3 | 2 | $0.138\,997\,995\,694\,60 \times 10^{1}$ |
| 21 | 3 | 4 | $-0.201\,899\,150\,235\,70 \times 10^{1}$ |
| 22 | 3 | 16 | $-0.821\,476\,371\,739\,63 \times 10^{-2}$ |
| 23 | 3 | 26 | $-0.475\,960\,357\,349\,23$ |
| 24 | 4 | 0 | $0.439\,840\,744\,735\,00 \times 10^{-1}$ |
| 25 | 4 | 2 | $-0.444\,764\,354\,287\,39$ |
| 26 | 4 | 4 | $0.905\,720\,707\,197\,33$ |
| 27 | 4 | 26 | $0.705\,224\,500\,879\,67$ |
| 28 | 5 | 1 | $0.107\,705\,126\,263\,32$ |
| 29 | 5 | 3 | $-0.329\,136\,232\,589\,54$ |
| 30 | 5 | 26 | $-0.508\,710\,620\,411\,58$ |
| 31 | 6 | 0 | $-0.221\,754\,008\,730\,96 \times 10^{-1}$ |
| 32 | 6 | 2 | $0.942\,607\,516\,650\,92 \times 10^{-1}$ |
| 33 | 6 | 26 | $0.164\,362\,784\,479\,61$ |
| 34 | 7 | 2 | $-0.135\,033\,722\,413\,48 \times 10^{-1}$ |
| 35 | 8 | 26 | $-0.148\,343\,453\,524\,72 \times 10^{-1}$ |
| 36 | 9 | 2 | $0.579\,229\,536\,280\,84 \times 10^{-3}$ |
| 37 | 9 | 26 | $0.323\,089\,047\,037\,11 \times 10^{-2}$ |
| 38 | 10 | 0 | $0.809\,648\,029\,962\,15 \times 10^{-4}$ |
| 39 | 10 | 1 | $-0.165\,576\,797\,950\,37 \times 10^{-3}$ |
| 40 | 11 | 26 | $-0.449\,238\,990\,618\,15 \times 10^{-4}$ |

In addition to representing the thermodynamic properties in the single-phase region, Equation (34) meets the phase-equilibrium condition (equality of specific Gibbs free energy for existing together vapour + liquid states; *see* the following table) along the saturation line for $T \geq 623.15$ K to $T_c$. Also, Equation (34) replicates precisely the critical parameters according to Equations (2) to (4) and yields zero for the initial two pressure derivatives concerning to density at the critical point.

All thermodynamic properties can be derived from Equation (34) by using the appropriate combinations of the dimensionless Helmholtz free energy and its derivatives. Relations between the relevant thermodynamic properties and $\varphi$ and its derivatives are summarized in following table.

All required derivatives of the dimensionless Helmholtz free energy are explicitly given in following table:

**Relations of Thermodynamic Properties to the Dimensionless Helmholtz free Energy φ and its Derivatives[1)] when Using Eq. (34)**

| *Property* | *Relation* |
|---|---|
| Pressure<br>$p = \rho^2 (\partial f/\partial \rho)_T$ | $\frac{p(\delta,\tau)}{\rho RT} = \delta\varphi_\delta$ |
| Specific Internal Energy<br>$u = f - T(\partial f/\partial T)_\rho$ | $\frac{u(\delta,\tau)}{RT} = \tau\varphi_\tau$ |
| Specific Entropy<br>$s = -(\partial f/\partial T)_\rho$ | $\frac{s(\delta,\tau)}{R} = \tau\varphi_\tau - \varphi$ |
| Specific Enthalpy<br>$h = f - T(\partial f/\partial T)_\rho + \rho(\partial f/\partial T)_T$ | $\frac{h(\delta,\tau)}{RT} = \tau\varphi_\tau + \delta\varphi_\delta$ |
| Specific Isobaric Heat Capacity<br>$c_p = (\partial h/\partial T)_p$ | $\frac{c_p(\delta,\tau)}{R} = -\tau^2\varphi_{\tau\tau} + \frac{(\delta\varphi_\delta - \delta\tau\varphi_{\delta\tau})^2}{2\delta\varphi_\delta + \delta^2\varphi_{\delta\delta}}$ |
| Specific Isochoric Heat Capacity<br>$c_v = (\partial u/\partial T)_\rho$ | $\frac{c_v(\delta,\tau)}{R} = -\tau^2\varphi_{\tau\tau}$ |
| Speed of Sound<br>$w = (\partial p/\partial \rho)_s^{1/2}$ | $\frac{w^2(\delta,\tau)}{RT} = 2\delta\varphi_\delta + \delta^2\varphi_{\delta\delta} - \frac{(\delta\varphi_\delta - \delta\tau\varphi_{\delta\tau})^2}{\tau\varphi_{\tau\tau}}$ |
| Phase-Equilibrium Condition | $\frac{p_s}{RT\rho'} = \delta'\varphi_\delta(\delta',\tau); \frac{p_s}{RT\rho''} = \delta''\varphi_\delta(\delta'',\tau)$ |
| (Maxwell criterion) | $\frac{p_s}{RT}\left(\frac{1}{\rho''} - \frac{1}{\rho'}\right) = \varphi(\delta',\tau) - \varphi(\delta'',\tau)$ |

[1)] $\varphi_\delta = \left[\frac{\partial\varphi}{\partial\delta}\right]_\tau$, $\varphi_{\delta\delta} = \left[\frac{\partial^2\varphi}{\partial\delta^2}\right]_\tau$, $\varphi_\tau = \left[\frac{\partial\varphi}{\partial\tau}\right]_\delta$, $\varphi_{\tau\tau} = \left[\frac{\partial^2\varphi}{\partial\tau^2}\right]_\delta$, $\varphi_{\delta\tau} = \left[\frac{\partial^2\varphi}{\partial\delta\partial\tau}\right]$

**The Dimensionless Helmholtz Free Energy Equation and its Derivatives [1)] A ccording to Equation (34)**

| | |
|---|---|
| $\varphi = n_1 \ln\delta + \sum_{i=2}^{40} n_i \delta^{I_i} \tau^{J_i}$ | |
| $\varphi_\delta = n_1/\delta + \sum_{i=2}^{40} n_i I_i \delta^{I_i - 1} \tau^{J_i}$ | $\varphi_{\delta\delta} = -n_1/\delta^2 + \sum_{i=2}^{40} n_i I_i (I_i - 1)\delta^{I_i - 2} \tau^{J_i}$ |
| $\varphi_\tau = 0 + \sum_{i=2}^{40} n_i \delta^{I_i} J_i \tau^{J_i - 1}$ | $\varphi_{\tau\tau} = 0 + \sum_{i=2}^{40} n_i \delta^{I_i} J_i (J_i - 1)\tau^{J_i - 2}$ |
| $\varphi_{\delta\tau} = 0 + \sum_{i=2}^{40} n_i I_i \delta^{I_i - 1} J_i \tau^{J_i - 1}$ | |
| [a] $\varphi_\delta = \left[\frac{\partial\varphi}{\partial\delta}\right]_\tau$, $\varphi_{\delta\delta} = \left[\frac{\partial^2\varphi}{\partial\delta^2}\right]_\tau$, $\varphi_\tau = \left[\frac{\partial\varphi}{\partial\tau}\right]_\delta$, $\varphi_{\tau\tau} = \left[\frac{\partial^2\varphi}{\partial\tau^2}\right]_\delta$, $\varphi_{\delta\tau} = \left[\frac{\partial^2\varphi}{\partial\delta\partial\tau}\right]$ | |

1) *Range of Validity*

Equation (34) covers region 3 of IAPWS-IF97 defined by the following range of temperature and pressure, see figure in clause 5:

$$623.15\ \text{K} \le T \le T(p)_{Eq.(6)} \qquad p(T)_{Eq.(5)} < p \le 100\ \text{MPa}$$

In addition to the properties in the stable single-phase region defined above, Equation (34) also yields reasonable values in the metastable regions (superheated liquid and sub-cooled steam) close to the saturated liquid and saturated vapour line.

**5.10.5.2** *Backward equations T(p,h)*

a) Backward Equation

The backward equation $T_{3a}$ $(p,h)$ for subregion 3a has the following dimensionless form:

$$\frac{T_{3a}(p,h)}{T^*} = \theta_{3a}(\pi,\eta) = \sum_{i=1}^{31} n_i (\pi + 0.240)^{I_i} (\eta - 0.615)^{J_i} \qquad ...(35)$$

where $\theta = T/T^*$, $\pi = p/p^*$ and $\eta = h/h^*$ with $T^* = 760$ K, $p^* = 100$ MPa and $h^* = 2300$ kJ kg$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (35) are listed in following table:

**Numerical Values of the Coefficients and Exponents of the Backward Equation $T_{3a}(p,h)$ for Sub-Region 3a in its Dimensionless form, Equation (35)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –12 | 0 | – 0.133 645 667 811 215 × $10^{-6}$ |
| 2 | –12 | 1 | 0.455 912 656 802 978 × $10^{-5}$ |
| 3 | –12 | 2 | – 0.146 294 640 700 979 × $10^{-4}$ |
| 4 | –12 | 6 | 0.639 341 312 970 080 × $10^{-2}$ |
| 5 | –12 | 14 | 0.372 783 927 268 847 × $10^{3}$ |
| 6 | –12 | 16 | – 0.718 654 377 460 447 × $10^{4}$ |
| 7 | –12 | 20 | 0.573 494 752 103 400 × $10^{6}$ |
| 8 | –12 | 22 | – 0.267 569 329 111 439 × $10^{7}$ |
| 9 | –10 | 1 | – 0.334 066 283 302 614 × $10^{-4}$ |
| 10 | –10 | 5 | – 0.245 479 214 069 597 × $10^{-1}$ |
| 11 | –10 | 12 | 0.478 087 847 764 996 × $10^{2}$ |
| 12 | –8 | 0 | 0.764 664 131 818 904 × $10^{-5}$ |
| 13 | –8 | 2 | 0.128 350 627 676 972 × $10^{-2}$ |
| 14 | –8 | 4 | 0.171 219 081 377 331 × $10^{-1}$ |
| 15 | –8 | 10 | – 0.851 007 304 583 213 × $10^{1}$ |
| 16 | –5 | 2 | – 0.136 513 461 629 781 × $10^{-1}$ |
| 17 | –3 | 0 | – 0.384 460 997 596 657 × $10^{-5}$ |
| 18 | –2 | 1 | 0.337 423 807 911 655 × $10^{-2}$ |
| 19 | –2 | 3 | – 0.551 624 873 066 791 |
| 20 | –2 | 4 | 0.729 202 277 107 470 |
| 21 | –1 | 0 | – 0.992 522 757 376 041 × $10^{-2}$ |
| 22 | –1 | 2 | – 0.119 308 831 407 288 |
| 23 | 0 | 0 | 0.793 929 190 615 421 |
| 24 | 0 | 1 | 0.454 270 731 799 386 |
| 25 | 1 | 1 | 0.209 998 591 259 910 |
| 26 | 3 | 0 | – 0.642 109 823 904 738 × $10^{-2}$ |
| 27 | 3 | 1 | – 0.235 155 868 604 540 × $10^{-1}$ |
| 28 | 4 | 0 | 0.252 233 108 341 612 × $10^{-2}$ |
| 29 | 4 | 3 | – 0.764 885 133 368 119 × $10^{-2}$ |
| 30 | 10 | 4 | 0.136 176 427 574 291 × $10^{-1}$ |
| 31 | 12 | 5 | – 0.133 027 883 575 669 × $10^{-1}$ |

The backward equation $T_{3b}$ $(p,h)$ for subregion 3b has the following dimensionless form:

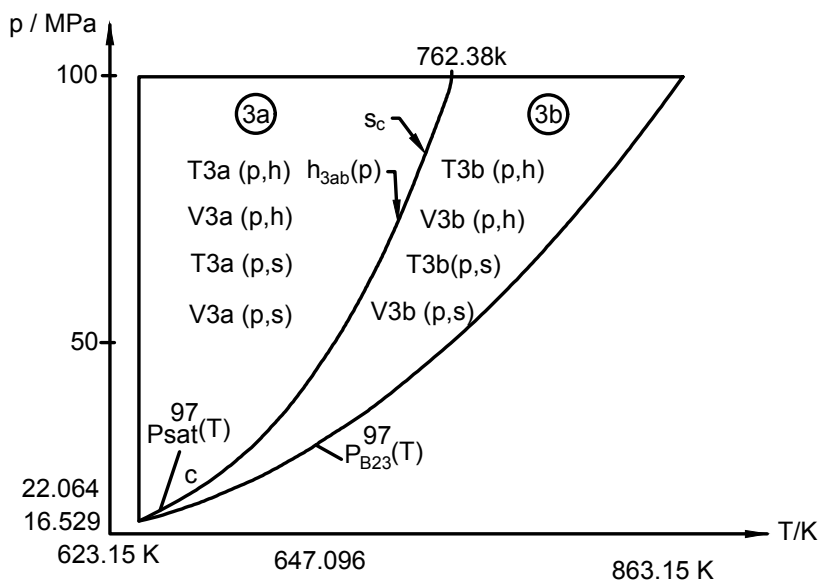



FIG. 5-4 DIVISION OF REGION 3 INTO TWO SUB-REGIONS 3A, 3B FOR THE BACK WARD EQUATIONS

$$\frac{T_{3b}(p,h)}{T^*} = \theta_{3b}(\pi,\eta) = \sum_{i=1}^{33} n_i (\pi + 0.298)^{I_i} (\eta - 0.720)^{J_i}$$

...(36)

where $\theta = T/T^*$, $\pi = p/p^*$ and $\eta = h/h^*$ with $T^* = 860$ K, $p^* = 100$ MPa and $h^* = 2\,800$ kJ kg$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (36) are listed in following table:

**Numerical values of the coefficients and exponents of the backward equation $T_{3b}(p,h)$ for sub-region 3b in its dimensionless form, Equation (36)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | – 12 | 0 | 0.323 254 573 644 920 × $10^{-4}$ |
| 2 | – 12 | 1 | – 0.127 575 556 587 181 × $10^{-3}$ |
| 3 | – 10 | 0 | – 0. 475 851 877 356 068 × $10^{-3}$ |
| 4 | – 10 | 1 | 0.156 183 014 181 602 × $10^{-2}$ |
| 5 | – 10 | 5 | 0.105 724 860 113 781 |
| 6 | – 10 | 10 | – 0.858 514 221 132 534 × $10^{2}$ |
| 7 | – 10 | 12 | 0.724 140 095 480 911 × $10^{3}$ |
| 8 | – 8 | 0 | 0.296 475 810 273 257 × $10^{-2}$ |
| 9 | – 8 | 1 | – 0.592 721 983 365 988 × $10^{-2}$ |
| 10 | – 8 | 2 | – 0.126 305 422 818 666 × $10^{-1}$ |
| 11 | – 8 | 4 | – 0.115 716 196 364 853 |
| 12 | – 8 | 10 | 0.849 000 969 739 595 × $10^{2}$ |
| 13 | – 6 | 0 | – 0.108 602 260 086 615 × $10^{-1}$ |
| 14 | – 6 | 1 | 0.154 304 475 328 851 × $10^{-1}$ |
| 15 | – 6 | 2 | 0.750 455 441 524 466 × 10– $^{1}$ |
| 16 | – 4 | 0 | 0.252 520 973 612 982 × $10^{-1}$ |
| 17 | – 4 | 1 | – 0.602 507 901 232 996 × $10^{-1}$ |
| 18 | – 3 | 5 | – 0.307 622 221 350 501 × $10^{1}$ |
| 19 | – 2 | 0 | – 0.574 011 959 864 879 × $10^{-1}$ |
| 20 | – 2 | 4 | 0.503 471 360 939 849 × $10^{1}$ |
| 21 | – 1 | 2 | – 0.925 081 888 584 834 |
| 22 | – 1 | 4 | 0.391 733 882 917 546 × $10^{1}$ |
| 23 | – 1 | 6 | – 0.773 146 007 130 190 × $10^{2}$ |
| 24 | – 1 | 10 | 0.949 308 762 098 587 × $10^{4}$ |
| 25 | – 1 | 14 | – 0.141 043 719 679 409 × $10^{7}$ |
| 26 | – 1 | 16 | 0.849 166 230 819 026 × $10^{7}$ |
| 27 | 0 | 0 | 0.861 095 729 446 704 |
| 28 | 0 | 2 | 0.323 346 442 811 720 |
| 29 | 1 | 1 | 0.873 281 936 020 439 |
| 30 | 3 | 1 | – 0.436 653 048 526 683 |
| 31 | 5 | 1 | 0.286 596 714 529 479 |
| 32 | 6 | 1 | – 0.131 778 331 276 228 |
| 33 | 8 | 1 | 0.676 682 064 330 275 × $10^{-2}$ |

2) *Numerical Consistency with the Basic Equation*

The maximum temperature differences and related root-mean-square differences between the calculated temperature Equations (35) and (36) and the IAPWS-IF97 basic equation $f_3$ $(v,T)$ in comparison with the permissible differences are listed in following table.

Maximum differences and root-mean-square differences of the temperature calculated from Eqs. (35) and (36) to the IAPWS-IF97 basic equation $f_3$ $(v,T)$ and related permissible values

| *Region/Sub region* | Equation | $\lvert\Delta T\rvert_{tol}$ | $\lvert\Delta T\rvert_{max}$ | $\lvert\Delta T\rvert_{RMS}$ |
|---|---|---|---|---|
| 3*a* | (XX) | 25 mK | 23.6 mK | 10.5 mK |
| 3*b* | (XX) | 25 mK | 19.6 mK | 9.6 mK |

b) Backward Equation $v(p,h)$

The backward equation $v_{3a}(p,h)$ for subregion 3a has the following dimensionless form:

$$\frac{v_{3a}(p,h)}{v^*} = \omega_{3a}(\pi,\eta) = \sum_{i=1}^{32} n_i (\pi + 0.128)^{I_i} (\eta - 0.727)^{J_i}$$

...(37)

where $\omega = v/v^*$, $\pi = p/p^*$ and $\eta = h/h^*$ with $v^* = 0.0028$ m$^3$ kg$^{-1}$, $p^* = 100$ MPa and $h^* = 2\,100$ kJ kg$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (37) are listed in following table:

**Numerical Values of the Coefficients and Exponents of the Backward Equation $v_{3a}(p,h)$ for Sub-Region 3a in its Dimensionless Form, Equation (37)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | – 12 | 6 | 0.529 944 062 966 028 × $10^{-2}$ |
| 2 | – 12 | 8 | – 0.170 099 690 234 461 |
| 3 | – 12 | 12 | 0.111 323 814 312 927 × $10^{2}$ |
| 4 | – 12 | 18 | – 0.217 898 123 145 125 × $10^{4}$ |
| 5 | – 10 | 4 | – 0.506 061 827 980 875 × $10^{-3}$ |
| 6 | – 10 | 7 | 0.556 495 239 685 324 |
| 7 | – 10 | 10 | – 0.943 672 726 094 016 × $10^{1}$ |
| 8 | – 8 | 5 | – 0.297 856 807 561 527 |
| 9 | – 8 | 12 | 0.939 353 943 717 186 × $10^{2}$ |
| 10 | – 6 | 3 | 0.192 944 939 465 981 × $10^{-1}$ |
| 11 | – 6 | 4 | 0.421 740 664 704 763 |
| 12 | – 6 | 22 | – 0.368 914 126 282 330 × $10^{7}$ |
| 13 | – 4 | 2 | – 0.737 566 847 600 639 × $10^{-2}$ |
| 14 | – 4 | 3 | – 0.354 753 242 424 366 |
| 15 | – 3 | 7 | – 0.199 768 169 338 727 × $10^{1}$ |
| 16 | – 2 | 3 | 0.115 456 297 059 049 × $10^{1}$ |
| 17 | – 2 | 16 | 0.568 366 875 815 960 × $10^{4}$ |
| 18 | – 1 | 0 | 0.808 169 540 124 668 × $10^{-2}$ |
| 19 | – 1 | 1 | 0.172 416 341 519 307 |

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 20 | – 1 | 2 | 0.104 270 175 292 927 × $10^1$ |
| 21 | – 1 | 3 | – 0.297 691 372 792 847 |
| 22 | 0 | 0 | 0.560 394 465 163 593 |
| 23 | 0 | 1 | 0.275 234 661 176 914 |
| 24 | 1 | 0 | – 0.148 347 894 866 012 |
| 25 | 1 | 1 | – 0.651 142 513 478 515 × $10^{-1}$ |
| 26 | 1 | 2 | – 0.292 468 715 386 302 × $10^1$ |
| 27 | 2 | 0 | 0.664 876 096 952 665 × $10^{-1}$ |
| 28 | 2 | 2 | 0.352 335 014 263 844 × $10^1$ |
| 29 | 3 | 0 | – 0.146 340 792 313 332 × $10^{-1}$ |
| 30 | 4 | 2 | – 0.224 503 486 668 184 × $10^1$ |
| 31 | 5 | 2 | 0.110 533 464 706 142 × $10^1$ |
| 32 | 8 | 2 | – 0.408 757 344 495 612 × $10^{-1}$ |

The backward equation $v_{3b}(p,h)$ for sub region 3b has the following dimensionless form:

$$\frac{v_{3b}(p,h)}{v^*} = \omega_{3b}(\pi,\eta) = \sum_{i=1}^{30} n_i (\pi + 0.0661)^{I_i} (\eta - 0.720)^{J_i} \quad ...(38)$$

where $\omega = v/v^*$, $\pi = p/p^*$ and $\eta = h/h^*$ with $v^* = 0.0088$ m$^3$ kg$^{-1}$, $p^* = 100$ MPa and $h^* = 2800$ kJ kg$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Eq. (38) are listed in following table:

**Numerical Values of the Coefficients and Exponents of the Backward Equation $v_{3b}(p,h)$ for Sub-Region 3a in its Dimensionless Form, Equation (38)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –12 | 0 | – 0.225 196 934 336 318 × $10^{-8}$ |
| 2 | –12 | 1 | 0.140 674 363 313 486 × $10^{-7}$ |
| 3 | –8 | 0 | 0.233 784 085 280 560 × $10^{-5}$ |
| 4 | –8 | 1 | – 0.331 833 715 229 001 × $10^{-4}$ |
| 5 | –8 | 3 | 0.107 956 778 514 318 × $10^{-2}$ |
| 6 | –8 | 6 | – 0.271 382 067 378 863 |
| 7 | –8 | 7 | 0.107 202 262 490 333 × $10^1$ |
| 8 | –8 | 8 | – 0.853 821 329 075 382 |
| 9 | –6 | 0 | – 0.215 214 194 340 526 × $10^{-4}$ |
| 10 | –6 | 1 | 0.769 656 088 222 730 × $10^{-3}$ |
| 11 | –6 | 2 | – 0.431 136 580 433 864 × $10^{-2}$ |
| 12 | –6 | 5 | 0.453 342 167 309 331 |
| 13 | –6 | 6 | – 0.507 749 535 873 652 |
| 14 | –6 | 10 | – 0.100 475 154 528 389 × $10^3$ |
| 15 | –4 | 3 | – 0.219 201 924 648 793 |
| 16 | –4 | 6 | – 0.321 087 965 668 917 × $10^1$ |
| 17 | –4 | 10 | 0.607 567 815 637 771 × $10^3$ |
| 18 | –3 | 0 | 0.557 686 450 685 932 × $10^{-3}$ |
| 19 | –3 | 2 | 0.187 499 040 029 550 |
| 20 | –2 | 1 | 0.905 368 030 448 107 × $10^{-2}$ |
| 21 | –2 | 2 | 0.285 417 173 048 685 |
| 22 | –1 | 0 | 0.329 924 030 996 098 × $10^{-1}$ |
| 23 | –1 | 1 | 0.239 897 419 685 483 |
| 24 | –1 | 4 | 0.482 754 995 951 394 × $10^1$ |
| 25 | –1 | 5 | – 0.118 035 753 702 231 × $10^2$ |
| 26 | 0 | 0 | 0.169 490 044 091 791 |
| 27 | 1 | 0 | – 0.179 967 222 507 787 × $10^{-1}$ |
| 28 | 1 | 1 | 0.371 810 116 332 674 × $10^{-1}$ |
| 29 | 2 | 2 | – 0.536 288 335 065 096 × $10^{-1}$ |
| 30 | 2 | 6 | 0.160 697 101 092 520 × $10^1$ |

1) *Numerical Consistency with the Basic Equation*

The following table also contains the maximum relative deviations and root-mean-square relative deviations for specific volume of Equations (37) and (38) from IAPWS-IF97:

**Maximum Differences and Root-Mean-Square Differences of the Specific Volume Calculated from Equations (37) and (38) to the IAPWS-IF97 Basic Equation $f_3$ ($v,T$) and Related Permissible Values**

| *Region/Sub region* | Equation | $\lvert\Delta v/v\rvert_{tol}$ | $\lvert v/v\Delta\rvert_{max}$ | $\lvert\Delta v/v\rvert_{RMS}$ |
|---|---|---|---|---|
| 3*a* | (37) | 0.01 % | 0.0080 % | 0.0032 % |
| 3*b* | (38) | 0.01 % | 0.0095 % | 0.0042 % |

c) Backward Equation $T(p,s)$

The backward equation $T_{3a}(p,s)$ for subregion 3a has the following dimensionless form:

$$\frac{T_{3a}(p,s)}{T^*} = \theta_{3a}(\pi,\sigma) = \sum_{i=1}^{33} n_i (\pi + 0.240)^{I_i} (\sigma - 0.703)^{J_i} \quad ...(39)$$

where $\theta = T/T^*$, $\pi = p/p^*$ and $\sigma = s/s^*$ with $T^* = 760$ K, $p^* = 100$ MPa and $s^* = 4.4$ kJ kg$^{-1}$ K$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (39) are listed in following table:

**Numerical Values of the Coefficients and Exponents of the Backward Equation $T_{3a}$ ($p$,$s$) for Sub-Region 3a in its Dimensionless form, Equation (39)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –12 | 28 | 0.150 042 008 263 875 × $10^{10}$ |
| 2 | –12 | 32 | – 0.159 397 258 480 424 × $10^{12}$ |
| 3 | –10 | 4 | 0.502 181 140 217 975 × $10^{-3}$ |
| 4 | –10 | 10 | – 0.672 057 767 855 466 × $10^{2}$ |
| 5 | –10 | 12 | 0.145 058 545 404 456 × $10^{4}$ |
| 6 | –10 | 14 | – 0.823 889 534 888 890 × $10^{4}$ |
| 7 | –8 | 5 | – 0.154 852 214 233 853 |
| 8 | –8 | 7 | 0.112 305 046 746 695 × $10^{2}$ |
| 9 | –8 | 8 | – 0.297 000 213 482 822 × $10^{2}$ |
| 10 | –8 | 28 | 0.438 565 132 635 495 × $10^{11}$ |
| 11 | – 6 | 2 | 0.137 837 838 635 464 × $10^{-2}$ |
| 12 | – 6 | 6 | – 0.297 478 527 157 462 × $10^{1}$ |
| 13 | – 6 | 32 | 0.971 777 947 349 413 × $10^{13}$ |
| 14 | – 5 | 0 | – 0.571 527 767 052 398 × $10^{-4}$ |
| 15 | – 5 | 14 | 0.288 307 949 778 420 × $10^{5}$ |
| 16 | – 5 | 32 | – 0.744 428 289 262 703 × $10^{14}$ |
| 17 | – 4 | 6 | 0.128 017 324 848 921 × $10^{2}$ |
| 18 | – 4 | 10 | – 0.368 275 545 889 071 × $10^{3}$ |
| 19 | – 4 | 36 | 0.664 768 904 779 177 × $10^{16}$ |
| 20 | – 2 | 1 | 0.449 359 251 958 880 × $10^{-1}$ |
| 21 | – 2 | 4 | – 0.422 897 836 099 655 × $10^{1}$ |
| 22 | – 1 | 1 | – 0.240 614 376 434 179 |
| 23 | – 1 | 6 | – 0.474 341 365 254 924 × $10^{1}$ |
| 24 | 0 | 0 | 0.724 093 999 126 110 |
| 25 | 0 | 1 | 0.923 874 349 695 897 |
| 26 | 0 | 4 | 0.399 043 655 281 015 × $10^{1}$ |
| 27 | 1 | 0 | 0.384 066 651 868 009 × $10^{-1}$ |
| 28 | 2 | 0 | – 0.359 344 365 571 848 × $10^{-2}$ |
| 29 | 2 | 3 | – 0.735 196 448 821 653 |
| 30 | 3 | 2 | 0.188 367 048 396 131 |
| 31 | 8 | 0 | 0.141 064 266 818 704 × $10^{-3}$ |
| 32 | 8 | 1 | – 0.257 418 501 496 337 × $10^{-2}$ |
| 33 | 10 | 2 | 0.123 220 024 851 555 × $10^{-2}$ |

The backward equation $T_{3b}$ ($p$,$s$) for sub region 3b has the following dimensionless form:

$$\frac{T_{3b}(p,s)}{T^*} = \theta_{3b}(\pi,\sigma) = \sum_{i=1}^{28} n_i (\pi + 0.760)^{I_i} (\sigma - 0.818)^{J_i} \quad ...(40)$$

where $\theta = T/T^*$, $\pi = p/p^*$ and $\sigma = s/s^*$ with $T^* = 860$ K, $p^* = 100$ MPa and $s^* = 5.3$ kJ kg$^{-1}$ K$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (40) are listed in following table:

**Numerical Values of the Coefficients and Exponents of the Backward Equation $T_{3b}$ ($p$,$s$) for Sub-Region 3b in its Dimensionless form, Equation (40)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –12 | 1 | 0.527 111 701 601 660 |
| 2 | –12 | 3 | – 0.401 317 830 052 742 × $10^{2}$ |
| 3 | –12 | 4 | 0.153020 073 134 484 × $10^{3}$ |
| 4 | –12 | 7 | – 0.224 799 398 218 827 × $10^{4}$ |
| 5 | –8 | 0 | – 0.193 993 484 669 048 |
| 6 | –8 | 1 | – 0.140 467 557 893 768 × $10^{1}$ |
| 7 | –8 | 3 | 0.426 799 878 114 024 × $10^{2}$ |
| 8 | –6 | 0 | 0.752 810 643 416 743 |
| 9 | –6 | 2 | 0.226 657 238 616 417 × $10^{2}$ |
| 10 | –6 | 4 | – 0.622 873 556 909 932 × $10^{3}$ |
| 11 | –5 | 0 | – 0.660 823 667 935 396 |
| 12 | –5 | 1 | 0.841 267 087 271 658 |
| 13 | –5 | 2 | – 0.253 717 501 764 397 × $10^{2}$ |
| 14 | –5 | 4 | 0.485 708 963 532 948 × $10^{3}$ |
| 15 | –5 | 6 | 0.880 531 517 490 555 × $10^{3}$ |
| 16 | –4 | 12 | 0.265 015 592 794 626 × $10^{7}$ |
| 17 | –3 | 1 | – 0.359 287 150 025 783 |
| 18 | –3 | 6 | – 0.656 991 567 673 753 × $10^{3}$ |
| 19 | –2 | 2 | 0.241 768 149 185 367 × $10^{1}$ |
| 20 | 0 | 0 | 0.856 873 461 222 588 |
| 21 | 2 | 1 | 0.655 143 675 313 458 |
| 22 | 3 | 1 | – 0.213 535 213 206 406 |
| 23 | 4 | 0 | 0.562 974 957 606 348 × $10^{-2}$ |
| 24 | 5 | 24 | – 0.316 955 725 450 471 × $10^{15}$ |
| 25 | 6 | 0 | – 0.699 997 000 152 457 × $10^{-3}$ |
| 26 | 8 | 3 | 0.119 845 803 210 767 × $10^{-1}$ |
| 27 | 12 | 1 | 0.193 848 122 022 095 × $10^{-4}$ |
| 28 | 14 | 2 | – 0.215 095 749 182 309 × $10^{-4}$ |

1) *Numerical Consistency with the Basic Equation*

The maximum temperature differences and related root-mean-square differences between the calculated

temperature Equations (39) and (40) and the IAPWS-IF97 basic equation $f_3(v,T)$ in comparison with the permissible differences are listed in following table:

**Maximum Differences and Root-Mean-Square Differences of the Temperature Calculated from Equations (39) and (40) to the IAPWS-IF97 Basic Equation $f_3(v, T)$ and Related Permissible Values**

| *Region/ Sub region* | Equation | $\lvert\Delta T\rvert_{tol}$ | $\lvert\Delta T\rvert_{max}$ | $\lvert\Delta T\rvert_{RMS}$ |
|---|---|---|---|---|
| 3*a* | (39) | 25 mK | 24.8 mK | 11.2 mK |
| 3*b* | (40) | 25 mK | 22.1 mK | 10.1 mK |

d) Backward Equation $v(p,s)$

The backward equation $v_{3a}(p,h)$ for sub region 3a has the following dimensionless form:

$$\frac{v_{3a}(p,s)}{v^*} = \omega_{3a}(\pi,\sigma) = \sum_{i=1}^{28} n_i (\pi + 0.187)^{I_i} (\sigma - 0.755)^{J_i} \quad ...(41)$$

where $\omega = v/v^*$, $\pi = p/p^*$ and $\sigma = s/s^*$ with $v^* = 0.0028\ \text{m}^3\ \text{kg}^{-1}$, $p^* = 100$ MPa and $s^* = 4.4\ \text{kJ kg}^{-1}\text{K}^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (41) are listed in following table:

**Numerical Values of the Coefficients and Exponents of the Backward Equation $v_{3a}(p,s)$ for Sub-Region 3a in its Dimensionless form, Equation (41)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –12 | 10 | $0.795\,544\,074\,093\,975 \times 10^{2}$ |
| 2 | –12 | 12 | $-0.238\,261\,242\,984\,590 \times 10^{4}$ |
| 3 | –12 | 14 | $0.176\,813\,100\,617\,787 \times 10^{5}$ |
| 4 | –10 | 4 | $-0.110\,524\,727\,080\,379 \times 10^{-2}$ |
| 5 | –10 | 8 | $-0.153\,213\,833\,655\,326 \times 10^{2}$ |
| 6 | –10 | 10 | $0.297\,544\,599\,376\,982 \times 10^{3}$ |
| 7 | –10 | 20 | $-0.350\,315\,206\,871\,242 \times 10^{8}$ |
| 8 | –8 | 5 | 0.277 513 761 062 119 |
| 9 | –8 | 6 | – 0.523 964 271 036 888 |
| 10 | –8 | 14 | $-0.148\,011\,182\,995\,403 \times 10^{6}$ |
| 11 | –8 | 16 | $0.160\,014\,899\,374\,266 \times 10^{7}$ |
| 12 | –6 | 28 | $0.170\,802\,322\,663\,427 \times 10^{13}$ |
| 13 | –5 | 1 | $0.246\,866\,996\,006\,494 \times 10^{-3}$ |
| 14 | –4 | 5 | $0.165\,326\,084\,797\,980 \times 10^{1}$ |
| 15 | –3 | 2 | – 0.118 008 384 666 987 |
| 16 | –3 | 4 | $0.253\,798\,642\,355\,900 \times 10^{1}$ |
| 17 | –2 | 3 | 0.965 127 704 669 424 |
| 18 | –2 | 8 | $-0.282\,172\,420\,532\,826 \times 10^{2}$ |
| 19 | –1 | 1 | 0.203 224 612 353 823 |
| 20 | –1 | 2 | $0.110\,648\,186\,063\,513 \times 10^{1}$ |
| 21 | 0 | 0 | 0.526 127 948 451 280 |
| 22 | 0 | 1 | 0.277 000 018 736 321 |
| 23 | 0 | 3 | $0.108\,153\,340\,501\,132 \times 10^{1}$ |
| 24 | 1 | 0 | $-0.744\,127\,885\,357\,893 \times 10^{-1}$ |
| 25 | 2 | 0 | $0.164\,094\,443\,541\,384 \times 10^{-1}$ |
| 26 | 4 | 2 | $-0.680\,468\,275\,301\,065 \times 10^{-1}$ |
| 27 | 5 | 2 | $0.257\,988\,576\,101\,640 \times 10^{-1}$ |
| 28 | 6 | 0 | $-0.145\,749\,861\,944\,416 \times 10^{-3}$ |

The backward equation $v_{3b}(p,h)$ for subregion 3b has the following dimensionless form:

$$\frac{v_{3b}(p,s)}{v^*} = \omega_{3b}(\pi,\sigma) = \sum_{i=1}^{31} n_i (\pi + 0.298)^{I_i} (\sigma - 0.816)^{J_i} \quad ...(42)$$

where $\omega = v/v^*$, $\pi = p/p^*$ and $\sigma = s/s^*$ with $v^* = 0.0088\ \text{m}^3\ \text{kg}^{-1}$, $p^* = 100$ MPa and $s^* = 5.3\ \text{kJ kg}^{-1}\text{K}^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Equation (42) are listed in following table:

**Numerical Values of the Coefficients and Exponents of the Backward Equation $v_{3b}(p,s)$ for Sub-Region 3a in its Dimensionless form, Equation (42)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –12 | 0 | $0.591\,599\,780\,322\,238 \times 10^{-4}$ |
| 2 | –12 | 1 | $-0.185\,465\,997\,137\,856 \times 10^{-2}$ |
| 3 | –12 | 2 | $0.104\,190\,510\,480\,013 \times 10^{-1}$ |
| 4 | –12 | 3 | $0.598\,647\,302\,038\,590 \times 10^{-2}$ |
| 5 | –12 | 5 | – 0.771 391 189 901 699 |
| 6 | –12 | 6 | $0.172\,549\,765\,557\,036 \times 10^{1}$ |
| 7 | –10 | 0 | $-0.467\,076\,079\,846\,526 \times 10^{-3}$ |
| 8 | –10 | 1 | $0.134\,533\,823\,384\,439 \times 10^{-1}$ |
| 9 | –10 | 2 | $-0.808\,094\,336\,805\,495 \times 10^{-1}$ |
| 10 | –10 | 4 | 0.508 139 374 365 767 |
| 11 | –8 | 0 | $0.128\,584\,643\,361\,683 \times 10^{-2}$ |
| 12 | –5 | 1 | $-0.163\,899\,353\,915\,435 \times 10^{1}$ |
| 13 | –5 | 2 | $0.586\,938\,199\,318\,063 \times 10^{1}$ |
| 14 | –5 | 3 | $-0.292\,466\,667\,918\,613 \times 10^{1}$ |
| 15 | –4 | 0 | $-0.614\,076\,301\,499\,537 \times 10^{-2}$ |
| 16 | –4 | 1 | $0.576\,199\,014\,049\,172 \times 10^{1}$ |
| 17 | –4 | 2 | $-0.121\,613\,320\,606\,788 \times 10^{2}$ |
| 18 | –4 | 3 | $0.167\,637\,540\,957\,944 \times 10^{1}$ |
| 19 | –3 | 1 | $-0.744\,135\,838\,773\,463 \times 10^{1}$ |
| 20 | –2 | 0 | $0.378\,168\,091\,437\,659 \times 10^{-1}$ |
| 21 | –2 | 1 | $0.401\,432\,203\,027\,688 \times 10^{1}$ |

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 22 | −2 | 2 | $0.160\,279\,837\,479\,185 \times 10^{2}$ |
| 23 | −2 | 3 | $0.317\,848\,779347\,728 \times 10^{1}$ |
| 24 | −2 | 4 | $-0.358\,362\,310\,304\,853 \times 10^{1}$ |
| 25 | −2 | 12 | $-0.115\,995260\,446\,827 \times 10^{7}$ |
| 26 | 0 | 0 | 0.199 256 573 577 909 |
| 27 | 0 | 1 | −0.122 270 624 794 624 |
| 28 | 0 | 2 | $-0.191\,449\,143\,716\,586 \times 10^{2}$ |
| 29 | 1 | 0 | $-0.150\,448\,002\,905\,284 \times 10^{-1}$ |
| 30 | 1 | 2 | $0.146\,407\,900\,162\,154 \times 10^{2}$ |
| 31 | 2 | 2 | $-\,0.327\,477\,787\,188\,230 \times 10^{1}$ |

1) *Numerical Consistency with the Basic Equation*

The following table contains the maximum relative deviations and root-mean-square relative deviations for specific volume of Equations (41) and (42) from IAPWS-IF97:

**Maximum Differences and Root-Mean-Square Differences of the Specific Volume Calculated from Equations (41) and (42) to the IAPWS-IF97 Basic Equation $f_3$ ($v$, $T$) and Related Permissible Values**

| *Region/Sub region* | Equation | $\lvert\Delta v/v\rvert_{tol}$ | $\lvert\Delta v/v\rvert_{max}$ | $\lvert\Delta T\rvert_{RMS}$ |
|---|---|---|---|---|
| 3*a* | (41) | 0.01 % | 0.0096 % | 0.0052 % |
| 3*b* | (42) | 0.01 % | 0.0077 % | 0.0037 % |

e) Backward Equation $v(p,T)$ for the subregions 3a to 3t

The backward equations $v_3$ ($p$,$T$) for the sub regions 3a to 3t, except for 3n, have the following dimensionless form:

$$\frac{v(p,T)}{v^*} = \omega(\pi,\theta) = \left[\sum_{i=1}^{N} n_i \left[(\pi - a)^c\right]^{I_i} \left[(\theta - b)^d\right]^{J_i}\right]^e \quad ...(43)$$

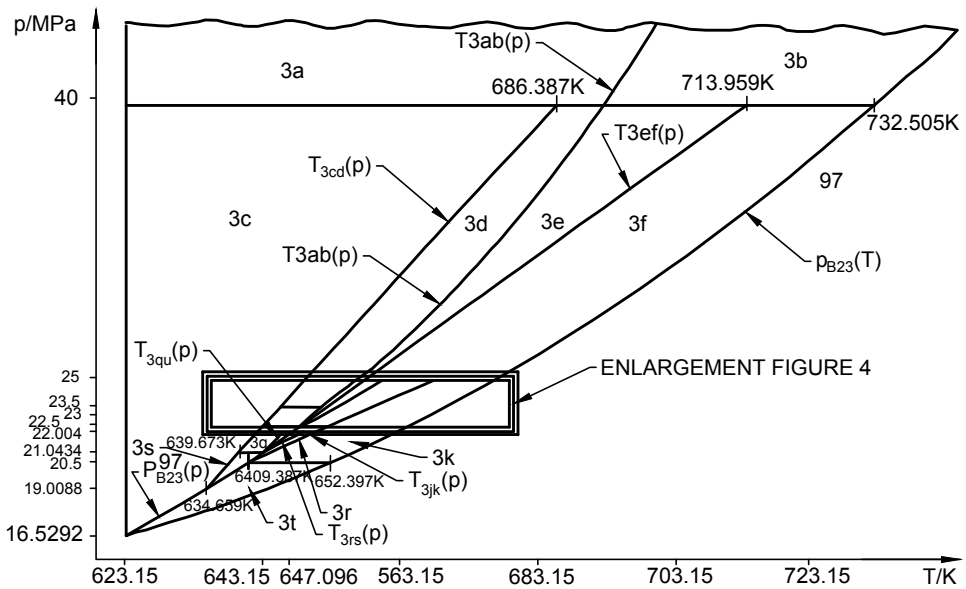



FIG. 5-5 DIVISION OF REGION 3 INTI SUB-REGIONS FOR THE BACKWARD EQUATION $v_3$(P)

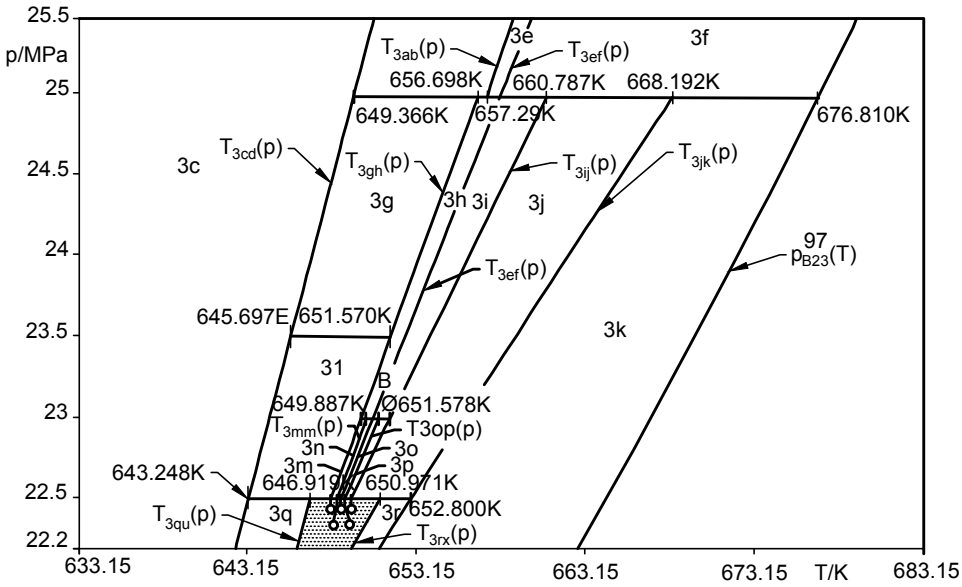



Fig. 5-6 Enlargement from Fig. 5-5 for the Sub-Regions 3c to 3r for the Equation $v_3(p,T)$

The equation for sub region 3n has the form:

$$\frac{v_{3n}(p,T)}{v^*} = \omega_{3n}(\pi,\theta) = exp\left\{\sum_{i=1}^{N} n_i (\pi - a)^{I_i} (\theta - b)^{J_i}\right\} \quad ...(44)$$

with $\omega = v/v^*$, $\pi = p/p^*$ and $\theta = T/T^*$. The reducing quantities $v^*$, $p^*$ and $T^*$, the number of coefficients $N$, the non-linear parameters $a$ and $b$, and the exponents $c$, $d$, and $e$ are listed in following table for the equations of the sub regions 3a to 3t.

The coefficients $n_i$ and exponents $I_i$ and $J_i$ of these equations are listed in following tables:

**Reducing Quantities $v^*$, $p^*$ and $T^*$, Number of Coefficients $N$, Non-Linear Parameters $a$ and $b$, and Exponents $c$, $d$, and $e$ for the $v_3$ $(p, T)$ Equations of the Sub regions 3a to 3t**

| *Sub region* | $v^*$ $m^3$ kg$^{-1}$ | *p*MPa* | *T*K* | *N* | *a* | *b* | *c* | *d* | *e* |
|---|---|---|---|---|---|---|---|---|---|
| 3*a* | 0.0024 | 100 | 760 | 30 | 0.085 | 0.817 | 1 | 1 | 1 |
| 3*b* | 0.0041 | 100 | 860 | 32 | 0.280 | 0.779 | 1 | 1 | 1 |
| 3*c* | 0.0022 | 40 | 690 | 35 | 0.259 | 0.903 | 1 | 1 | 1 |
| 3*d* | 0.0029 | 40 | 690 | 38 | 0.559 | 0.939 | 1 | 1 | 4 |
| 3*e* | 0.0032 | 40 | 710 | 29 | 0.587 | 0.918 | 1 | 1 | 1 |
| 3*f* | 0.0064 | 40 | 730 | 42 | 0.587 | 0.891 | 0.5 | 1 | 4 |
| 3*g* | 0.0027 | 25 | 660 | 38 | 0.872 | 0.971 | 1 | 1 | 4 |
| 3*h* | 0.0032 | 25 | 660 | 29 | 0.898 | 0.983 | 1 | 1 | 4 |
| 3*i* | 0.0041 | 25 | 660 | 42 | 0.910 | 0.984 | 0.5 | 1 | 4 |
| 3*j* | 0.0054 | 25 | 670 | 29 | 0.875 | 0.964 | 0.5 | 1 | 4 |
| 3*k* | 0.0077 | 25 | 680 | 34 | 0.802 | 0.935 | 1 | 1 | 1 |
| 3*l* | 0.0026 | 24 | 650 | 43 | 0.908 | 0.989 | 1 | 1 | 4 |

| *Sub region* | $v^*m^3\,kg^{-1}$ | *p*MPa* | *T*K* | *N* | *a* | *b* | *c* | *d* | *e* |
|---|---|---|---|---|---|---|---|---|---|
| 3*m* | 0.0028 | 23 | 650 | 40 | 1.00 | 0.997 | 1 | 0.25 | 1 |
| 3*n* | 0.0031 | 23 | 650 | 39 | 0.976 | 0.997 | - | - | - |
| 3*o* | 0.0034 | 23 | 650 | 24 | 0.974 | 0.996 | 0.5 | 1 | 1 |
| 3*p* | 0.0041 | 23 | 650 | 27 | 0.972 | 0.997 | 0.5 | 1 | 1 |
| 3*q* | 0.0022 | 23 | 650 | 24 | 0.848 | 0.983 | 1 | 1 | 4 |
| 3*r* | 0.0054 | 23 | 650 | 27 | 0.874 | 0.982 | 1 | 1 | 1 |
| 3*s* | 0.0022 | 21 | 640 | 29 | 0.886 | 0.990 | 1 | 1 | 4 |
| 3*t* | 0.0088 | 20 | 650 | 33 | 0.803 | 1.02 | 1 | 1 | 1 |

**Coefficients and Exponents of the Backward Equation $v_{3a}$ (*p*, *T*) for Sub Region 3a**

| *i* | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –12 | 5 | $0.110\,879\,558\,823\,853 \times 10^{-2}$ |
| 2 | –12 | 10 | $0.572\,616\,740\,810\,616 \times 10^{3}$ |
| 3 | –12 | 12 | $-0.767\,051\,948\,380\,852 \times 10^{5}$ |
| 4 | –10 | 5 | $-0.253\,321\,069\,529\,674 \times 10^{-1}$ |
| 5 | –10 | 10 | $0.628\,008\,049\,345\,689 \times 10^{4}$ |
| 6 | –10 | 12 | $0.234\,105\,654\,131\,876 \times 10^{6}$ |
| 7 | –8 | 5 | 0.216 867 826 045 856 |
| 8 | –8 | 8 | $-0.156\,237\,904\,341\,963 \times 10^{3}$ |
| 9 | –8 | 10 | $-0.269\,893\,956\,176\,613 \times 10^{5}$ |
| 10 | –6 | 1 | $-0.180\,407\,100\,085\,505 \times 10^{-3}$ |
| 11 | –5 | 1 | $0.116\,732\,227\,668\,261 \times 10^{-2}$ |
| 12 | –5 | 5 | $0.266\,987\,040\,856\,040 \times 10^{2}$ |
| 13 | –5 | 10 | $0.282\,776\,617\,243\,286 \times 10^{5}$ |
| 14 | –4 | 8 | $-0.242\,431\,520\,029\,523 \times 10^{4}$ |
| 15 | –3 | 0 | $0.435\,217\,323\,022\,733 \times 10^{-3}$ |
| 16 | –3 | 1 | $-0.122\,494\,831\,387\,441 \times 10^{-1}$ |
| 17 | –3 | 3 | $0.179\,357\,604\,019\,989 \times 10^{1}$ |
| 18 | –3 | 6 | $0.442\,729\,521\,058\,314 \times 10^{2}$ |
| 19 | –2 | 0 | $-0.593\,223\,489\,018\,342 \times 10^{-2}$ |
| 20 | –2 | 2 | 0.453 186 261 685 774 |
| 21 | –2 | 3 | $0.135\,825\,703\,129\,140 \times 10^{1}$ |
| 22 | –1 | 0 | $0.408\,748\,415\,856\,745 \times 10^{-1}$ |
| 23 | –1 | 1 | 0.474 686 397 863 312 |
| 24 | –1 | 2 | $0.118\,646\,814\,997\,915 \times 10^{1}$ |
| 25 | 0 | 0 | 0.546 987 265 727 549 |
| 26 | 0 | 1 | 0.195 266 770 452 643 |
| 27 | 1 | 0 | $-0.502\,268\,790\,869\,663 \times 10^{-1}$ |
| 28 | 1 | 2 | – 0.369 645 308 193 377 |
| 29 | 2 | 0 | $0.633\,828\,037\,528\,420 \times 10^{-2}$ |
| 30 | 2 | 2 | $0.797\,441\,793\,901\,017 \times 10^{-1}$ |

**Coefficients and Exponents of the Backward Equation $v_{3b}$ (*p*, *T*) for Sub Region 3b**

| *i* | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –12 | 10 | $-0.827\,670\,470\,003\,621 \times 10^{-1}$ |
| 2 | –12 | 12 | $0.416\,887\,126\,010\,565 \times 10^{2}$ |
| 3 | –10 | 8 | $0.483\,651\,982\,197\,059 \times 10^{-1}$ |
| 4 | –10 | 14 | $-0.291\,032\,084\,950\,276 \times 10^{5}$ |
| 5 | –8 | 8 | $-0.111\,422\,582\,236\,948 \times 10^{3}$ |
| 6 | –6 | 5 | $-0.202\,300\,083\,904\,014 \times 10^{-1}$ |
| 7 | –6 | 6 | $0.294\,002\,509\,338\,515 \times 10^{3}$ |
| 8 | –6 | 8 | $0.140\,244\,997\,609\,658 \times 10^{3}$ |
| 9 | –5 | 5 | $-0.344\,384\,158\,811\,459 \times 10^{3}$ |
| 10 | –5 | 8 | $0.361\,182\,452\,612\,149 \times 10^{3}$ |
| 11 | –5 | 10 | $-0.140\,699\,677\,420\,738 \times 10^{4}$ |
| 12 | – 4 | 2 | $-0.202\,023\,902\,676\,481 \times 10^{-2}$ |
| 13 | –4 | 4 | $0.171\,346\,792\,457\,471 \times 10^{3}$ |
| 14 | –4 | 5 | $-0.425\,597\,804\,058\,632 \times 10^{1}$ |
| 15 | –3 | 0 | $0.691\,346\,085\,000\,334 \times 10^{-5}$ |
| 16 | –3 | 1 | $0.151\,140\,509\,678\,925 \times 10^{-2}$ |
| 17 | –3 | 2 | $-0.416\,375\,290\,166\,236 \times 10^{-1}$ |
| 18 | –3 | 3 | $-0.413\,754\,957\,011\,042 \times 10^{2}$ |
| 19 | –3 | 5 | $-0.506\,673\,295\,721\,637 \times 10^{2}$ |
| 20 | –2 | 0 | $-0.572\,212\,965\,569\,023 \times 10^{-3}$ |

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 21 | –2 | 2 | $0.608\,817\,368\,401\,785 \times 10^{1}$ |
| 22 | –2 | 5 | $0.239\,600\,660\,256\,161 \times 10^{2}$ |
| 23 | –1 | 0 | $0.122\,261\,479\,925\,384 \times 10^{-1}$ |
| 24 | –1 | 2 | $0.216\,356\,057\,692\,938 \times 10^{1}$ |
| 25 | 0 | 0 | 0.398 198 903 368 642 |
| 26 | 0 | 1 | – 0.116 892 827 834 085 |
| 27 | 1 | 0 | – 0.102 845 919 373 532 |
| 28 | 1 | 2 | – 0.492 676 637 589 284 |
| 29 | 2 | 0 | $0.655\,540\,456\,406\,790 \times 10^{-1}$ |
| 30 | 3 | 2 | – 0.240 462 535 078 530 |
| 31 | 4 | 0 | $-\,0.269\,798\,180\,310\,075 \times 10^{-1}$ |
| 32 | 4 | 1 | 0.128 369 435 967 012 |

**Coefficients and Exponents of the Backward Equation $v_{3c}$ ($p$, $T$) for Sub Region 3c**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –12 | 6 | $0.311\,967\,788\,763\,030 \times 10^{1}$ |
| 2 | –12 | 8 | $0.276\,713\,458\,847\,564 \times 10^{5}$ |
| 3 | –12 | 10 | $0.322\,583\,103\,403\,269 \times 10^{8}$ |
| 4 | –10 | 6 | $-\,0.342\,416\,065\,095\,363 \times 10^{3}$ |
| 5 | –10 | 8 | $-\,0.899\,732\,529\,907\,377 \times 10^{6}$ |
| 6 | –10 | 10 | $-\,0.793\,892\,049\,821\,251 \times 10^{8}$ |
| 7 | –8 | 5 | $0.953\,193\,003\,217\,388 \times 10^{2}$ |
| 8 | –8 | 6 | $0.229\,784\,742\,345\,072 \times 10^{4}$ |
| 9 | –8 | 7 | $0.175\,336\,675\,322\,499 \times 10^{6}$ |
| 10 | –6 | 8 | $0.791\,214\,365\,222\,792 \times 10^{7}$ |
| 11 | –5 | 1 | $0.319\,933\,345\,844\,209 \times 10^{-4}$ |
| 12 | –5 | 4 | $-\,0.659\,508\,863\,555\,767 \times 10^{2}$ |
| 13 | –5 | 7 | $-\,0.833\,426\,563\,212\,851 \times 10^{6}$ |
| 14 | –4 | 2 | $0.645\,734\,680\,583\,292 \times 10^{-1}$ |
| 15 | –4 | 8 | $-\,0.382\,031\,020\,570\,813 \times 10^{7}$ |
| 16 | –3 | 0 | $0.406\,398\,848\,470\,079 \times 10^{-4}$ |
| 17 | –3 | 3 | $0.310\,327\,498\,492\,008 \times 10^{2}$ |
| 18 | –2 | 0 | $-\,0.892\,996\,718\,483\,724 \times 10^{-3}$ |
| 19 | –2 | 4 | $0.234\,604\,891\,591\,616 \times 10^{3}$ |
| 20 | –2 | 5 | $0.377\,515\,668\,966\,951 \times 10^{4}$ |
| 21 | –1 | 0 | $0.158\,646\,812\,591\,361 \times 10^{-1}$ |
| 22 | –1 | 1 | 0.707 906 336 241 843 |
| 23 | –1 | 2 | $0.126\,016\,225\,146\,570 \times 10^{2}$ |
| 24 | 0 | 0 | 0.736 143 655 772 152 |
| 25 | 0 | 1 | 0.676 544 268 999 101 |
| 26 | 0 | 2 | $-\,0.178\,100\,588\,189\,137 \times 10^{2}$ |
| 27 | 1 | 0 | – 0.156 531 975 531 713 |
| 28 | 1 | 2 | $0.117\,707\,430\,048\,158 \times 10^{2}$ |
| 29 | 2 | 0 | $0.840\,143\,653\,860\,447 \times 10^{-1}$ |
| 30 | 2 | 1 | – 0.186 442 467 471 949 |
| 31 | 2 | 3 | $-\,0.440\,170\,203\,949\,645 \times 10^{2}$ |
| 32 | 2 | 7 | $0.123\,290\,423\,502\,494 \times 10^{7}$ |
| 33 | 3 | 0 | $-\,0.240\,650\,039\,730\,845 \times 10^{-1}$ |
| 34 | 3 | 7 | $-\,0.107\,077\,716\,660\,869 \times 10^{7}$ |
| 35 | 8 | 1 | $0.438\,319\,858\,566\,475 \times 10^{-1}$ |

**Coefficients and Exponents of the Backward Equation $v_{3d}$ ($p$, $T$) for Sub Region 3d**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | – 12 | 4 | $-\,0.452\,484\,847\,171\,645 \times 10^{-9}$ |
| 2 | – 12 | 6 | $0.315\,210\,389\,538\,801 \times 10^{-4}$ |
| 3 | – 12 | 7 | $-\,0.214\,991\,352\,047\,545 \times 10^{-2}$ |
| 4 | – 12 | 10 | $0.508\,058\,874\,808\,345 \times 10^{3}$ |
| 5 | – 12 | 12 | $-\,0.127\,123\,036\,845\,932 \times 10^{8}$ |
| 6 | – 12 | 16 | $0.115\,371\,133\,120\,497 \times 10^{13}$ |
| 7 | – 10 | 0 | $-\,0.197\,805\,728\,776\,273 \times 10^{-15}$ |
| 8 | – 10 | 2 | $0.241\,554\,806\,033\,972 \times 10^{-10}$ |
| 9 | – 10 | 4 | $-\,0.156\,481\,703\,640\,525 \times 10^{-5}$ |
| 10 | – 10 | 6 | $0.277\,211\,346\,836\,625 \times 10^{-2}$ |
| 11 | – 10 | 8 | $-\,0.203\,578\,994\,462\,286 \times 10^{2}$ |
| 12 | – 10 | 10 | $0.144\,369\,489\,909\,053 \times 10^{7}$ |
| 13 | – 10 | 14 | $-\,0.411\,254\,217\,946\,539 \times 10^{11}$ |
| 14 | – 8 | 3 | $0.623\,449\,786\,243\,773 \times 10^{-5}$ |
| 15 | – 8 | 7 | $-\,0.221\,774\,281\,146\,038 \times 10^{2}$ |
| 16 | – 8 | 8 | $-\,0.689\,315\,087\,933\,158 \times 10^{5}$ |
| 17 | – 8 | 10 | $-\,0.195\,419\,525\,060\,713 \times 10^{8}$ |

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 18 | – 6 | 6 | $0.316\,373\,510\,564\,015 \times 10^{4}$ |
| 19 | – 6 | 8 | $0.224\,040\,754\,426\,988 \times 10^{7}$ |
| 20 | – 5 | 1 | $-0.436\,701\,347\,922\,356 \times 10^{-5}$ |
| 21 | – 5 | 2 | $-0.404\,213\,852\,833\,996 \times 10^{-3}$ |
| 22 | – 5 | 5 | $-0.348\,153\,203\,414\,663 \times 10^{3}$ |
| 23 | – 5 | 7 | $-0.385\,294\,213\,555\,289 \times 10^{6}$ |
| 24 | – 4 | 0 | $0.135\,203\,700\,099\,403 \times 10^{-6}$ |
| 25 | – 4 | 1 | $0.134\,648\,383\,271\,089 \times 10^{-3}$ |
| 26 | – 4 | 7 | $0.125\,031\,835\,351\,736 \times 10^{6}$ |
| 27 | – 3 | 2 | $0.968\,123\,678\,455\,841 \times 10^{-1}$ |
| 28 | – 3 | 4 | $0.225\,660\,517\,512\,438 \times 10^{3}$ |
| 29 | – 2 | 0 | $-0.190\,102\,435\,341\,872 \times 10^{-3}$ |
| 30 | – 2 | 1 | $-0.299\,628\,410\,819\,229 \times 10^{-1}$ |
| 31 | – 1 | 0 | $0.500\,833\,915\,372\,121 \times 10^{-2}$ |
| 32 | – 1 | 1 | 0.387 842 482 998 411 |
| 33 | – 1 | 5 | $-0.138\,535\,367\,777\,182 \times 10^{4}$ |
| 34 | 0 | 0 | 0.870 745 245 971 773 |
| 35 | 0 | 2 | $0.171\,946\,252\,068\,742 \times 10^{1}$ |
| 36 | 1 | 0 | $-0.326\,650\,121\,426\,383 \times 10^{-1}$ |
| 37 | 1 | 6 | $0.498\,044\,171\,727\,877 \times 10^{4}$ |
| 38 | 3 | 0 | $0.551\,478\,022\,765\,087 \times 10^{-2}$ |

**Coefficients and Exponents of the Backward Equation $v_{3e}$ ($p$, $T$) for Sub Region 3e**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –12 | 14 | $0.715\,815\,808\,404\,721 \times 10^{9}$ |
| 2 | –12 | 16 | $-0.114\,328\,360\,753\,449 \times 10^{12}$ |
| 3 | –10 | 3 | $0.376\,531\,002\,015\,720 \times 10^{-11}$ |
| 4 | –10 | 6 | $-0.903\,983\,668\,691\,157 \times 10^{-4}$ |
| 5 | –10 | 10 | $0.665\,695\,908\,836\,252 \times 10^{6}$ |
| 6 | –10 | 14 | $0.535\,364\,174\,960\,127 \times 10^{10}$ |
| 7 | –10 | 16 | $0.794\,977\,402\,335\,603 \times 10^{11}$ |
| 8 | –8 | 7 | $0.922\,230\,563\,421\,437 \times 10^{2}$ |
| 9 | –8 | 8 | $-0.142\,586\,073\,991\,215 \times 10^{6}$ |
| 10 | –8 | 10 | $-0.111\,796\,381\,424\,162 \times 10^{7}$ |
| 11 | – 6 | 6 | $0.896\,121\,629\,640\,760 \times 10^{4}$ |
| 12 | – 5 | 6 | $-0.669\,989\,239\,070\,491 \times 10^{4}$ |
| 13 | – 4 | 2 | $0.451\,242\,538\,486\,834 \times 10^{-2}$ |
| 14 | – 4 | 4 | $-0.339\,731\,325\,977\,713 \times 10^{2}$ |
| 15 | – 3 | 2 | $-0.120\,523\,111\,552\,278 \times 10^{1}$ |
| 16 | – 3 | 6 | $0.475\,992\,667\,717\,124 \times 10^{5}$ |
| 17 | – 3 | 7 | $-0.266\,627\,750\,390\,341 \times 10^{6}$ |
| 18 | – 2 | 0 | $-0.153\,314\,954\,386\,524 \times 10^{-3}$ |
| 19 | – 2 | 1 | 0.305 638 404 828 265 |
| 20 | – 2 | 3 | $0.123\,654\,999\,499\,486 \times 10^{3}$ |
| 21 | – 2 | 4 | $-0.104\,390\,794\,213\,011 \times 10^{4}$ |
| 22 | – 1 | 0 | $-0.157\,496\,516\,174\,308 \times 10^{-1}$ |
| 23 | 0 | 0 | 0.685 331 118 940 253 |
| 24 | 0 | 1 | $0.178\,373\,462\,873\,903 \times 10^{1}$ |
| 25 | 1 | 0 | – 0.544 674 124 878 910 |
| 26 | 1 | 4 | $0.204\,529\,931\,318\,843 \times 10^{4}$ |
| 27 | 1 | 6 | $-0.228\,342\,359\,328\,752 \times 10^{5}$ |
| 28 | 2 | 0 | 0.413 197 481 515 899 |
| 29 | 2 | 2 | $-0.341\,931\,835\,910\,405 \times 10^{2}$ |

**Coefficients and Exponents of the Backward Equation $v_{3f}$ ($p$, $T$) for Sub Region 3f**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | 0 | – 3 | $0.251\,756\,547\,792\,325 \times 10^{-7}$ |
| 2 | 0 | – 2 | $0.601\,307\,193\,668\,763 \times 10^{-5}$ |
| 3 | 0 | – 1 | $-0.100\,615\,977\,450\,049 \times 10^{-2}$ |
| 4 | 0 | 0 | – 0.999 969 140 252 192 |
| 5 | 0 | 1 | $0.214\,107\,759\,236\,486 \times 10^{1}$ |
| 6 | 0 | 2 | $-0.165\,175\,571\,959\,086 \times 10^{2}$ |
| 7 | 1 | – 1 | $0.141\,987\,303\,638\,727 \times 10^{-2}$ |
| 8 | 1 | 1 | $-0.269\,251\,915\,156\,554 \times 10^{1}$ |
| 9 | 1 | 2 | $0.349\,741\,815\,858\,722 \times 10^{2}$ |
| 10 | 1 | 3 | $-0.300\,208\,695\,771\,783 \times 10^{2}$ |
| 11 | 2 | 0 | $0.131\,546\,288\,252\,539 \times 10^{1}$ |
| 12 | 2 | 1 | $0.839\,091\,277\,286\,169 \times 10^{1}$ |
| 13 | 3 | – 5 | $-0.181\,545\,608\,337\,015 \times 10^{-9}$ |
| 14 | 3 | – 2 | $0.591\,099\,206\,478\,909 \times 10^{-3}$ |
| 15 | 3 | 0 | $0.152\,115\,067\,087\,106 \times 10^{1}$ |
| 16 | 4 | – 3 | $-0.252\,956\,470\,663\,225 \times 10^{-4}$ |
| 17 | 5 | – 8 | $0.100\,726\,265\,203\,786 \times 10^{-14}$ |

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 18 | 5 | 1 | $-0.149\,774\,533\,860\,650 \times 10^{1}$ |
| 19 | 6 | – 6 | $0.793\,940\,970\,562\,969 \times 10^{-9}$ |
| 20 | 7 | – 4 | $-0.150\,290\,891\,264\,717 \times 10^{-3}$ |
| 21 | 7 | 1 | $0.151\,205\,531\,275\,133 \times 10^{1}$ |
| 22 | 10 | – 6 | $0.470\,942\,606\,221\,652 \times 10^{-5}$ |
| 23 | 12 | – 10 | $0.195\,049\,710\,391\,712 \times 10^{-12}$ |
| 24 | 12 | – 8 | $-0.911\,627\,886\,266\,077 \times 10^{-8}$ |
| 25 | 12 | – 4 | $0.604\,374\,640\,201\,265 \times 10^{-3}$ |
| 26 | 14 | – 12 | $-0.225\,132\,933\,900\,136 \times 10^{-15}$ |
| 27 | 14 | – 10 | $0.610\,916\,973\,582\,981 \times 10^{-11}$ |
| 28 | 14 | – 8 | $-0.303\,063\,908\,043\,404 \times 10^{-6}$ |
| 29 | 14 | – 6 | $-0.137\,796\,070\,798\,409 \times 10^{-4}$ |
| 30 | 14 | – 4 | $-0.919\,296\,736\,666\,106 \times 10^{-3}$ |
| 31 | 16 | – 10 | $0.639\,288\,223\,132\,545 \times 10^{-9}$ |
| 32 | 16 | – 8 | $0.753\,259\,479\,898\,699 \times 10^{-6}$ |
| 33 | 18 | – 12 | $-0.400\,321\,478\,682\,929 \times 10^{-12}$ |
| 34 | 18 | – 10 | $0.756\,140\,294\,351\,614 \times 10^{-8}$ |
| 35 | 20 | – 12 | $-0.912\,082\,054\,034\,891 \times 10^{-11}$ |
| 36 | 20 | – 10 | $-0.237\,612\,381\,140\,539 \times 10^{-7}$ |
| 37 | 22 | – 6 | $0.269\,586\,010\,591\,874 \times 10^{-4}$ |
| 38 | 24 | – 12 | $-0.732\,828\,135\,157\,839 \times 10^{-10}$ |
| 39 | 24 | – 12 | $0.241\,995\,578\,306\,660 \times 10^{-9}$ |
| 40 | 28 | – 4 | $-0.405\,735\,532\,730\,322 \times 10^{-3}$ |
| 41 | 32 | – 12 | $0.189\,424\,143\,498\,011 \times 10^{-9}$ |
| 42 | 5 | – 12 | $-0.486\,632\,965\,074\,563 \times 10^{-9}$ |

**Coefficients and Exponents of the Backward Equation $v_{3g}$ ($p$, $T$) for Sub Region 3g**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –12 | 7 | $0.412\,209\,020\,652\,996 \times 10^{-4}$ |
| 2 | –12 | 12 | $-0.114\,987\,238\,280\,587 \times 10^{7}$ |
| 3 | –12 | 14 | $0.948\,180\,885\,032\,080 \times 10^{10}$ |
| 4 | –12 | 18 | $-0.195\,788\,865\,718\,971 \times 10^{18}$ |
| 5 | –12 | 22 | $0.496\,250\,704\,871\,300 \times 10^{25}$ |
| 6 | –12 | 24 | $-0.105\,549\,884\,548\,496 \times 10^{29}$ |
| 7 | –10 | 14 | $-0.758\,642\,165\,988\,278 \times 10^{12}$ |
| 8 | –10 | 20 | $-0.922\,172\,769\,596\,101 \times 10^{23}$ |
| 9 | –10 | 24 | $0.725\,379\,072\,059\,348 \times 10^{30}$ |
| 10 | –8 | 7 | $-0.617\,718\,249\,205\,859 \times 10^{2}$ |
| 11 | –8 | 8 | $0.107\,555\,033\,344\,858 \times 10^{5}$ |
| 12 | –8 | 10 | $-0.379\,545\,802\,336\,487 \times 10^{8}$ |
| 13 | –8 | 12 | $0.228\,646\,846\,221\,831 \times 10^{12}$ |
| 14 | –6 | 8 | $-0.499\,741\,093\,010\,619 \times 10^{7}$ |
| 15 | –6 | 22 | $-0.280\,214\,310\,054\,101 \times 10^{31}$ |
| 16 | –5 | 7 | $0.104\,915\,406\,769\,586 \times 10^{7}$ |
| 17 | –5 | 20 | $0.613\,754\,229\,168\,619 \times 10^{28}$ |
| 18 | –4 | 22 | $0.802\,056\,715\,528\,378 \times 10^{32}$ |
| 19 | –3 | 7 | $-0.298\,617\,819\,828\,065 \times 10^{8}$ |
| 20 | –2 | 3 | $-0.910\,782\,540\,134\,681 \times 10^{2}$ |
| 21 | –2 | 5 | $0.135\,033\,227\,281\,565 \times 10^{6}$ |
| 22 | –2 | 14 | $-0.712\,949\,383\,408\,211 \times 10^{19}$ |
| 23 | –2 | 24 | $-0.104\,578\,785\,289\,542 \times 10^{37}$ |
| 24 | –1 | 2 | $0.304\,331\,584\,444\,093 \times 10^{2}$ |
| 25 | –1 | 8 | $0.593\,250\,797\,959\,445 \times 10^{10}$ |
| 26 | –1 | 18 | $-0.364\,174\,062\,110\,798 \times 10^{28}$ |
| 27 | 0 | 0 | $0.921\,791\,403\,532\,461$ |
| 28 | 0 | 1 | $-0.337\,693\,609\,657\,471$ |
| 29 | 0 | 2 | $-0.724\,644\,143\,758\,508 \times 10^{2}$ |
| 30 | 1 | 0 | $-0.110\,480\,239\,272\,601$ |
| 31 | 1 | 1 | $0.536\,516\,031\,875\,059 \times 10^{1}$ |
| 32 | 1 | 3 | $-0.291\,441\,872\,156\,205 \times 10^{4}$ |
| 33 | 3 | 24 | $0.616\,338\,176\,535\,305 \times 10^{40}$ |
| 34 | 5 | 22 | $-0.120\,889\,175\,861\,180 \times 10^{39}$ |
| 35 | 6 | 12 | $0.818\,396\,024\,524\,612 \times 10^{23}$ |
| 36 | 8 | 3 | $0.940\,781\,944\,835\,829 \times 10^{9}$ |
| 37 | 10 | 0 | $-0.367\,279\,669\,545\,448 \times 10^{5}$ |
| 38 | 10 | 6 | $-0.837\,513\,931\,798\,655 \times 10^{16}$ |

**Coefficients and Exponents of the Backward Equation $v_{3h}$ ($p$, $T$) for Sub Region 3h**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –12 | 8 | $0.561\,379\,678\,887\,577 \times 10^{-1}$ |
| 2 | –12 | 12 | $0.774\,135\,421\,587\,083 \times 10^{10}$ |
| 3 | –10 | 4 | $0.111\,482\,975\,877\,938 \times 10^{-8}$ |
| 4 | –10 | 6 | $-0.143\,987\,128\,208\,183 \times 10^{-2}$ |
| 5 | –10 | 8 | $0.193\,696\,558\,764\,920 \times 10^{4}$ |
| 6 | –10 | 10 | $-0.605\,971\,823\,585\,005 \times 10^{9}$ |
| 7 | –10 | 14 | $0.171\,951\,568\,124\,337 \times 10^{14}$ |

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 8 | –10 | 16 | – 0.185 461 154 985 145 × $10^{17}$ |
| 9 | –8 | 0 | 0.387 851 168 078 010 × $10^{-16}$ |
| 10 | –8 | 1 | – 0.395 464 327 846 105 × $10^{-13}$ |
| 11 | –8 | 6 | – 0.170 875 935 679 023 × $10^{3}$ |
| 12 | –8 | 7 | – 0.212 010 620 701 220× $10^{4}$ |
| 13 | –8 | 8 | 0.177 683 337 348 191 × $10^{8}$ |
| 14 | –6 | 4 | 0.110 177 443 629 575 × $10^{2}$ |
| 15 | –6 | 6 | – 0.234 396 091 693 313× $10^{6}$ |
| 16 | –6 | 8 | – 0.656 174 421 999 594 × $10^{7}$ |
| 17 | –5 | 2 | 0.156 362 212 977 396 × $10^{-4}$ |
| 18 | –5 | 3 | – 0.212 946 257 021 400 × $10^{1}$ |
| 19 | –5 | 4 | 0.135 249 306 374 858 × $10^{2}$ |
| 20 | –4 | 2 | 0.177 189 164 145 813 |
| 21 | –4 | 4 | 0.139 499 167 345 464 × $10^{4}$ |
| 22 | –3 | 1 | – 0.703 670 932 036 388 × $10^{-2}$ |
| 23 | –3 | 2 | – 0.152 011 044 389 648 |
| 24 | –2 | 0 | 0.981 916 922 991 113 × $10^{-4}$ |
| 25 | –1 | 0 | 0.147 199 658 618 076 × $10^{-2}$ |
| 26 | –1 | 2 | 0.202 618 487 025 578 × $10^{2}$ |
| 27 | 0 | 0 | 0.899 345 518 944 240 |
| 28 | 1 | 0 | – 0.211 346 402 240 858 |
| 29 | 1 | 2 | 0.249 971 752 957 491 × $10^{2}$ |

**Coefficients and Exponents of the Backward Equation $v_{3i}$ ($p$, $T$) for Sub Region 3i**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | 0 | 0 | 0.106 905 684 359 136 × $10^{1}$ |
| 2 | 0 | 1 | – 0.148 620 857 922 333 × $10^{1}$ |
| 3 | 0 | 10 | 0.259 862 256 980 408 × $10^{15}$ |
| 4 | 1 | –4 | – 0.446 352 055 678 749 × $10^{-11}$ |
| 5 | 1 | –2 | – 0.566 620 757 170 032 × $10^{-6}$ |
| 6 | 1 | –1 | – 0.235 302 885 736 849 × $10^{-2}$ |
| 7 | 1 | 0 | – 0.269 226 321 968 839 |
| 8 | 2 | 0 | 0.922 024 992 944 392 × $10^{1}$ |
| 9 | 3 | –5 | 0.357 633 505 503 772 × $10^{-11}$ |
| 10 | 3 | 0 | – 0.173 942 565 562 222 × $10^{2}$ |
| 11 | 4 | –3 | 0.700 681 785 556 229 × $10^{-5}$ |
| 12 | 4 | –2 | – 0.267 050 351 075 768 × $10^{-3}$ |
| 13 | 4 | –1 | – 0.231 779 669 675 624 × $10^{1}$ |
| 14 | 5 | –6 | – 0.753 533 046 979 752 × $10^{-12}$ |
| 15 | 5 | –1 | 0.481 337 131 452 891 × $10^{1}$ |
| 16 | 5 | 12 | – 0.223 286 270 422 356 × $10^{22}$ |
| 17 | 7 | –4 | – 0.118 746 004 987 383 × $10^{-4}$ |
| 18 | 7 | –3 | 0.646 412 934 136 496 × $10^{-2}$ |
| 19 | 8 | –6 | – 0.410 588 536 330 937 × $10^{-9}$ |
| 20 | 8 | 10 | 0.422 739 537 057 241 × $10^{20}$ |
| 21 | 10 | –8 | 0.313 698 180 473 812 × $10^{-12}$ |
| 22 | 12 | –12 | 0.164 395 334 345 040 × $10^{-23}$ |
| 23 | 12 | –6 | – 0.339 823 323 754 373 × $10^{-5}$ |
| 24 | 12 | –4 | – 0.135 268 639 905 021 × $10^{-1}$ |
| 25 | 14 | –10 | – 0.723 252 514 211 625 × $10^{-14}$ |
| 26 | 14 | –8 | 0.184 386 437 538 366 × $10^{-8}$ |
| 27 | 14 | –4 | – 0.463 959 533 752 385 × $10^{-1}$ |
| 28 | 14 | 5 | – 0.992 263 100 376 750 × $10^{14}$ |
| 29 | 18 | –12 | 0.688 169 154 439 335 × $10^{-16}$ |
| 30 | 18 | –10 | – 0.222 620 998 452 197 × $10^{-10}$ |
| 31 | 18 | –8 | – 0.540 843 018 624 083 × $10^{-7}$ |
| 32 | 18 | –6 | 0.345 570 606 200 257 × $10^{-2}$ |
| 33 | 18 | 2 | 0.422 275 800 304 086 × $10^{11}$ |
| 34 | 20 | –12 | – 0.126 974 478 770 487 × $10^{-14}$ |
| 35 | 20 | –10 | 0.927 237 985 153 679 × $10^{-9}$ |
| 36 | 22 | –12 | 0.612 670 812 016 489 × $10^{-13}$ |
| 37 | 24 | –12 | – 0.722 693 924 063 497 × $10^{-11}$ |
| 38 | 24 | –8 | – 0.383 669 502 636 822 × $10^{-3}$ |
| 39 | 32 | –10 | 0.374 684 572 410 204 × $10^{-3}$ |
| 40 | 32 | –5 | – 0.931 976 897 511 086 × $10^{5}$ |
| 41 | 36 | –10 | – 0.247 690 616 026 922 × $10^{-1}$ |
| 42 | 36 | –8 | 0.658 110 546 759 474 × $10^{2}$ |

**Coefficients and Exponents of the Backward Equation $v_{3j}$ ($p$,$T$) for Sub Region 3j**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | 0 | –1 | – 0.111 371 317 395 540 × $10^{-3}$ |
| 2 | 0 | 0 | 0.100 342 892 423 685 × $10^{1}$ |
| 3 | 0 | 1 | 0.530 615 581 928 979 × $10^{1}$ |
| 4 | 1 | –2 | 0.179 058 760 078 792 × $10^{-5}$ |
| 5 | 1 | –1 | – 0.728 541 958 464 774 × $10^{-3}$ |
| 6 | 1 | 1 | – 0.187 576 133 371 704 × $10^{2}$ |

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 7 | 2 | –1 | $0.199\,060\,874\,071\,849 \times 10^{-2}$ |
| 8 | 2 | 1 | $0.243\,574\,755\,377\,290 \times 10^{2}$ |
| 9 | 3 | –2 | $-0.177\,040\,785\,499\,444 \times 10^{-3}$ |
| 10 | 4 | –2 | $-0.259\,680\,385\,227\,130 \times 10^{-2}$ |
| 11 | 4 | 2 | $-0.198\,704\,578\,406\,823 \times 10^{3}$ |
| 12 | 5 | –3 | $0.738\,627\,790\,224\,287 \times 10^{-4}$ |
| 13 | 5 | –2 | $-0.236\,264\,692\,844\,138 \times 10^{-2}$ |
| 14 | 5 | 0 | $-0.161\,023\,121\,314\,333 \times 10^{1}$ |
| 15 | 6 | 3 | $0.622\,322\,971\,786\,473 \times 10^{4}$ |
| 16 | 10 | –6 | $-0.960\,754\,116\,701\,669 \times 10^{-8}$ |
| 17 | 12 | –8 | $-0.510\,572\,269\,720\,488 \times 10^{-10}$ |
| 18 | 12 | –3 | $0.767\,373\,781\,404\,211 \times 10^{-2}$ |
| 19 | 14 | –10 | $0.663\,855\,469\,485\,254 \times 10^{-14}$ |
| 20 | 14 | –8 | $-0.717\,590\,735\,526\,745 \times 10^{-9}$ |
| 21 | 14 | –5 | $0.146\,564\,542\,926\,508 \times 10^{-4}$ |
| 22 | 16 | –10 | $0.309\,029\,474\,277\,013 \times 10^{-11}$ |
| 23 | 18 | –12 | $-0.464\,216\,300\,971\,708 \times 10^{-15}$ |
| 24 | 20 | –12 | $-0.390\,499\,637\,961\,161 \times 10^{-13}$ |
| 25 | 20 | –10 | $-0.236\,716\,126\,781\,431 \times 10^{-9}$ |
| 26 | 24 | –12 | $0.454\,652\,854\,268\,717 \times 10^{-11}$ |
| 27 | 24 | –6 | $-0.422\,271\,787\,482\,497 \times 10^{-2}$ |
| 28 | 28 | –12 | $0.283\,911\,742\,354\,706 \times 10^{-10}$ |
| 29 | 28 | –5 | $0.270\,929\,002\,720\,228 \times 10^{1}$ |

**Coefficients and Exponents of the Backward Equation $v_{3k}$ ($p$, $T$) for Sub Region 3k**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –2 | 10 | $-0.401\,215\,699\,576\,099 \times 10^{9}$ |
| 2 | –2 | 12 | $0.484\,501\,478\,318\,406 \times 10^{11}$ |
| 3 | –1 | –5 | $0.394\,721\,471\,363\,678 \times 10^{-14}$ |
| 4 | –1 | 6 | $0.372\,629\,967\,374\,147 \times 10^{5}$ |
| 5 | 0 | –12 | $-0.369\,794\,374\,168\,666 \times 10^{-29}$ |
| 6 | 0 | –6 | $-0.380\,436\,407\,012\,452 \times 10^{-14}$ |
| 7 | 0 | –2 | $0.475\,361\,629\,970\,233 \times 10^{-6}$ |
| 8 | 0 | –1 | $-0.879\,148\,916\,140\,706 \times 10^{-3}$ |
| 9 | 0 | 0 | $0.844\,317\,863\,844\,331$ |
| 10 | 0 | 1 | $0.122\,433\,162\,656\,600 \times 10^{2}$ |
| 11 | 0 | 2 | $-0.104\,529\,634\,830\,279 \times 10^{3}$ |
| 12 | 0 | 3 | $0.589\,702\,771\,277\,429 \times 10^{3}$ |
| 13 | 0 | 14 | $-0.291\,026\,851\,164\,444 \times 10^{14}$ |
| 14 | 1 | –3 | $0.170\,343\,072\,841\,850 \times 10^{-5}$ |
| 15 | 1 | –2 | $-0.277\,617\,606\,975\,748 \times 10^{-3}$ |
| 16 | 1 | 0 | $-0.344\,709\,605\,486\,686 \times 10^{1}$ |
| 17 | 1 | 1 | $0.221\,333\,862\,447\,095 \times 10^{2}$ |
| 18 | 1 | 2 | $-0.194\,646\,110\,037\,079 \times 10^{3}$ |
| 19 | 2 | –8 | $0.808\,354\,639\,772\,825 \times 10^{-15}$ |
| 20 | 2 | –6 | $-0.180\,845\,209\,145\,470 \times 10^{-10}$ |
| 21 | 2 | –3 | $-0.696\,664\,158\,132\,412 \times 10^{-5}$ |
| 22 | 2 | –2 | $-0.181\,057\,560\,300\,994 \times 10^{-2}$ |
| 23 | 2 | 0 | $0.255\,830\,298\,579\,027 \times 10^{1}$ |
| 24 | 2 | 4 | $0.328\,913\,873\,658\,481 \times 10^{4}$ |
| 25 | 5 | –12 | $-0.173\,270\,241\,249\,904 \times 10^{-18}$ |
| 26 | 5 | –6 | $-0.661\,876\,792\,558\,034 \times 10^{-6}$ |
| 27 | 5 | –3 | $-0.395\,688\,923\,421\,250 \times 10^{-2}$ |
| 28 | 6 | –12 | $0.604\,203\,299\,819\,132 \times 10^{-17}$ |
| 29 | 6 | –10 | $-0.400\,879\,935\,920\,517 \times 10^{-13}$ |
| 30 | 6 | –8 | $0.160\,751\,107\,464\,958 \times 10^{-8}$ |
| 31 | 6 | –5 | $0.383\,719\,409\,025\,556 \times 10^{-4}$ |
| 32 | 8 | –12 | $-0.649\,565\,446\,702\,457 \times 10^{-14}$ |
| 33 | 10 | –12 | $-0.149\,095\,328\,506\,000 \times 10^{-11}$ |
| 34 | 12 | –10 | $0.541\,449\,377\,329\,581 \times 10^{-8}$ |

**Coefficients and Exponents of the Backward Equation $v_{3l}$ ($p$, $T$) for Sub Region 3l**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –12 | 14 | $0.260\,702\,058\,647\,537 \times 10^{10}$ |
| 2 | –12 | 16 | $-0.188\,277\,213\,604\,704 \times 10^{15}$ |
| 3 | –12 | 18 | $0.554\,923\,870\,289\,667 \times 10^{19}$ |
| 4 | –12 | 20 | $-0.758\,966\,946\,387\,758 \times 10^{23}$ |
| 5 | –12 | 22 | $0.413\,865\,186\,848\,908 \times 10^{27}$ |
| 6 | –10 | 14 | $-0.815\,038\,000\,738\,060 \times 10^{12}$ |
| 7 | –10 | 24 | $-0.381\,458\,260\,489\,955 \times 10^{33}$ |
| 8 | –8 | 6 | $-0.123\,239\,564\,600\,519 \times 10^{-1}$ |
| 9 | –8 | 10 | $0.226\,095\,631\,437\,174 \times 10^{8}$ |
| 10 | –8 | 12 | $-0.495\,017\,809\,506\,720 \times 10^{12}$ |
| 11 | –8 | 14 | $0.529\,482\,996\,422\,863 \times 10^{16}$ |
| 12 | –8 | 18 | $-0.444\,359\,478\,746\,295 \times 10^{23}$ |
| 13 | –8 | 24 | $0.521\,635\,864\,527\,315 \times 10^{35}$ |
| 14 | –8 | 36 | $-0.487\,095\,672\,740\,742 \times 10^{55}$ |
| 15 | –6 | 8 | $-0.714\,430\,209\,937\,547 \times 10^{6}$ |
| 16 | –5 | 4 | $0.127\,868\,634\,615\,495$ |
| 17 | –5 | 5 | $-0.100\,752\,127\,917\,598 \times 10^{2}$ |
| 18 | –4 | 7 | $0.777\,451\,437\,960\,990 \times 10^{7}$ |
| 19 | –4 | 16 | $-0.108\,105\,480\,796\,471 \times 10^{25}$ |

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 20 | –3 | 1 | – 0.357 578 581 169 659 × $10^{-5}$ |
| 21 | –3 | 3 | – 0.212 857 169 423 484 × $10^{1}$ |
| 22 | –3 | 18 | 0.270 706 111 085 238 × $10^{30}$ |
| 23 | –3 | 20 | – 0.695 953 622 348 829 × $10^{33}$ |
| 24 | –2 | 2 | 0.110 609 027 472 280 |
| 25 | –2 | 3 | 0.721 559 163 361 354 × $10^{2}$ |
| 26 | –2 | 10 | – 0.306 367 307 532 219 × $10^{15}$ |
| 27 | –1 | 0 | 0.265 839 618 885 530 × $10^{-4}$ |
| 28 | –1 | 1 | 0.253 392 392 889 754 × $10^{-1}$ |
| 29 | –1 | 3 | – 0.214 443 041 836 579 × $10^{3}$ |
| 30 | 0 | 0 | 0.937 846 601 489 667 |
| 31 | 0 | 1 | 0.223 184 043 101 700 × $10^{1}$ |
| 32 | 0 | 2 | 0.338 401 222 509 191 × $10^{2}$ |
| 33 | 0 | 12 | 0.494 237 237 179 718 × $10^{21}$ |
| 34 | 1 | 0 | – 0.198 068 404 154 428 |
| 35 | 1 | 16 | – 0.141 415 349 881 140 × $10^{31}$ |
| 36 | 2 | 1 | – 0.993 862 421 613 651 × $10^{2}$ |
| 37 | 4 | 0 | 0.125 070 534 142 731 × $10^{3}$ |
| 38 | 5 | 0 | – 0.996 473 529 004 439 × $10^{3}$ |
| 39 | 5 | 1 | 0.473 137 909 872 765 × $10^{5}$ |
| 40 | 6 | 14 | 0.116 662 121 219 322 × $10^{33}$ |
| 41 | 10 | 4 | – 0.315 874 976 271 533 × $10^{16}$ |
| 42 | 10 | 12 | – 0.445 703 369 196 945 × $10^{33}$ |
| 43 | 14 | 10 | 0.642 794 932 373 694 × $10^{33}$ |

**Coefficients and Exponents of the Backward Equation $v_{3m}$ ($p$, $T$) for Sub Region 3m**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | 0 | 0 | 0.811 384 363 481 847 |
| 2 | 3 | 0 | – 0.568 199 310 990 094 × $10^{4}$ |
| 3 | 8 | 0 | – 0.178 657 198 172 556 × $10^{11}$ |
| 4 | 20 | 2 | 0.795 537 657 613 427 × $10^{32}$ |
| 5 | 1 | 5 | – 0.814 568 209 346 872 × $10^{5}$ |
| 6 | 3 | 5 | – 0.659 774 567 602 874 × $10^{8}$ |
| 7 | 4 | 5 | – 0.152 861 148 659 302 × $10^{11}$ |
| 8 | 5 | 5 | – 0.560 165 667 510 446 × $10^{12}$ |
| 9 | 1 | 6 | 0.458 384 828 593 949 × $10^{6}$ |
| 10 | 6 | 6 | – 0.385 754 000 383 848 × $10^{14}$ |
| 11 | 2 | 7 | 0.453 735 800 004 273 × $10^{8}$ |
| 12 | 4 | 8 | 0.939 454 935 735 563 × $10^{12}$ |
| 13 | 14 | 8 | 0.266 572 856 432 938 × $10^{28}$ |
| 14 | 2 | 10 | – 0.547 578 313 899 097 × $10^{10}$ |
| 15 | 5 | 10 | 0.200 725 701 112 386 × $10^{15}$ |
| 16 | 3 | 12 | 0.185 007 245 563 239 × $10^{13}$ |
| 17 | 0 | 14 | 0.185 135 446 828 337 × $10^{9}$ |
| 18 | 1 | 14 | – 0.170 451 090 076 385 × $10^{12}$ |
| 19 | 1 | 18 | 0.157 890 366 037 614 × $10^{15}$ |
| 20 | 1 | 20 | – 0.202 530 509 748 774 × $10^{16}$ |
| 21 | 28 | 20 | 0.368 193 926 183 570 × $10^{60}$ |
| 22 | 2 | 22 | 0.170 215 539 458 936 × $10^{18}$ |
| 23 | 16 | 22 | 0.639 234 909 918 741 × $10^{42}$ |
| 24 | 0 | 24 | – 0.821 698 160 721 956 × $10^{15}$ |
| 25 | 5 | 24 | – 0.795 260 241 872 306 × $10^{24}$ |
| 26 | 0 | 28 | 0.233 415 869 478 510 × $10^{18}$ |
| 27 | 3 | 28 | – 0.600 079 934 586 803 × $10^{23}$ |
| 28 | 4 | 28 | 0.594 584 382 273 384 × $10^{25}$ |
| 29 | 12 | 28 | 0.189 461 279 349 492 × $10^{40}$ |
| 30 | 16 | 28 | – 0.810 093 428 842 645 × $10^{46}$ |
| 31 | 1 | 32 | 0.188 813 911 076 809 × $10^{22}$ |
| 32 | 8 | 32 | 0.111 052 244 098 768 × $10^{36}$ |
| 33 | 14 | 32 | 0.291 133 958 602 503 × $10^{46}$ |
| 34 | 0 | 36 | – 0.329 421 923 951 460 × $10^{22}$ |
| 35 | 2 | 36 | – 0.137 570 282 536 696 × $10^{26}$ |
| 36 | 3 | 36 | 0.181 508 996 303 902 × $10^{28}$ |
| 37 | 4 | 36 | – 0.346 865 122 768 353 × $10^{30}$ |
| 38 | 8 | 36 | – 0.211 961 148 774 260 × $10^{38}$ |
| 39 | 14 | 36 | – 0.128 617 899 887 675 × $10^{49}$ |
| 40 | 24 | 36 | 0.479 817 895 699 239 × $10^{65}$ |

**Coefficients and Exponents of the Backward Equation $v_{3n}$ ($p$, $T$) for Sub Region 3n**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | 0 | –12 | 0.280 967 799 943 151 × $10^{-38}$ |
| 2 | 3 | –12 | 0.614 869 006 573 609 × $10^{-30}$ |
| 3 | 4 | –12 | 0.582 238 667 048 942 × $10^{-27}$ |
| 4 | 6 | –12 | 0.390 628 369 238 462 × $10^{-22}$ |
| 5 | 7 | –12 | 0.821 445 758 255 119 × $10^{-20}$ |
| 6 | 10 | –12 | 0.402 137 961 842 776 × $10^{-14}$ |
| 7 | 12 | –12 | 0.651 718 171 878 301 × $10^{-12}$ |
| 8 | 14 | –12 | – 0.211 773 355 803 058 × $10^{-7}$ |
| 9 | 18 | –12 | 0.264 953 354 380 072 × $10^{-2}$ |
| 10 | 0 | –10 | – 0.135 031 446 451 331 × $10^{-31}$ |
| 11 | 3 | –10 | – 0.607 246 643 970 893 × $10^{-23}$ |
| 12 | 5 | –10 | – 0.402 352 115 234 494 × $10^{-18}$ |
| 13 | 6 | –10 | – 0.744 938 506 925 544 × $10^{-16}$ |

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 14 | 8 | –10 | $0.189\,917\,206\,526\,237 \times 10^{-12}$ |
| 15 | 12 | –10 | $0.364\,975\,183\,508\,473 \times 10^{-5}$ |
| 16 | 0 | –8 | $0.177\,274\,872\,361\,946 \times 10^{-25}$ |
| 17 | 3 | –8 | $-0.334\,952\,758\,812\,999 \times 10^{-18}$ |
| 18 | 7 | –8 | $-0.421\,537\,726\,098\,389 \times 10^{-8}$ |
| 19 | 12 | –8 | $-0.391\,048\,167\,929\,649 \times 10^{-1}$ |
| 20 | 2 | –6 | $0.541\,276\,911\,564\,176 \times 10^{-13}$ |
| 21 | 3 | –6 | $0.705\,412\,100\,773\,699 \times 10^{-11}$ |
| 22 | 4 | –6 | $0.258\,585\,887\,897\,486 \times 10^{-8}$ |
| 23 | 2 | –5 | $-0.493\,111\,362\,030\,162 \times 10^{-10}$ |
| 24 | 4 | –5 | $-0.158\,649\,699\,894\,543 \times 10^{-5}$ |
| 25 | 7 | –5 | $-0.525\,037\,427\,886\,100$ |
| 26 | 4 | –4 | $0.220\,019\,901\,729\,615 \times 10^{-2}$ |
| 27 | 3 | –3 | $-0.643\,064\,132\,636\,925 \times 10^{-2}$ |
| 28 | 5 | –3 | $0.629\,154\,149\,015\,048 \times 10^{2}$ |
| 29 | 6 | –3 | $0.135\,147\,318\,617\,061 \times 10^{3}$ |
| 30 | 0 | –2 | $0.240\,560\,808\,321\,713 \times 10^{-6}$ |
| 31 | 0 | –1 | $-0.890\,763\,306\,701\,305 \times 10^{-3}$ |
| 32 | 3 | –1 | $-0.440\,209\,599\,407\,714 \times 10^{4}$ |
| 33 | 1 | 0 | $-0.302\,807\,107\,747\,776 \times 10^{3}$ |
| 34 | 0 | 1 | $0.159\,158\,748\,314\,599 \times 10^{4}$ |
| 35 | 1 | 1 | $0.232\,534\,272\,709\,876 \times 10^{6}$ |
| 36 | 0 | 2 | $-0.792\,681\,207\,132\,600 \times 10^{6}$ |
| 37 | 1 | 4 | $-0.869\,871\,364\,662\,769 \times 10^{11}$ |
| 38 | 0 | 5 | $0.354\,542\,769\,185\,671 \times 10^{12}$ |
| 39 | 1 | 6 | $0.400\,849\,240\,129\,329 \times 10^{15}$ |

**Coefficients and Exponents of the Backward Equation $v_{3o}$ ($p$, $T$) for Sub Region 3o**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | 0 | –12 | $0.128\,746\,023\,979\,718 \times 10^{-34}$ |
| 2 | 0 | –4 | $-0.735\,234\,770\,382\,342 \times 10^{-11}$ |
| 3 | 0 | –1 | $0.289\,078\,692\,149\,150 \times 10^{-2}$ |
| 4 | 2 | –1 | $0.244\,482\,731\,907\,223$ |
| 5 | 3 | –10 | $0.141\,733\,492\,030\,985 \times 10^{-23}$ |
| 6 | 4 | –12 | $-0.354\,533\,853\,059\,476 \times 10^{-28}$ |
| 7 | 4 | –8 | $-0.594\,539\,202\,901\,431 \times 10^{-17}$ |
| 8 | 4 | –5 | $-0.585\,188\,401\,782\,779 \times 10^{-8}$ |
| 9 | 4 | –4 | $0.201\,377\,325\,411\,803 \times 10^{-5}$ |
| 10 | 4 | –1 | $0.138\,647\,388\,209\,306 \times 10^{1}$ |
| 11 | 5 | –4 | $-0.173\,959\,365\,084\,772 \times 10^{-4}$ |
| 12 | 5 | –3 | $0.137\,680\,878\,349\,369 \times 10^{-2}$ |
| 13 | 6 | –8 | $0.814\,897\,605\,805\,513 \times 10^{-14}$ |
| 14 | 7 | –12 | $0.425\,596\,631\,351\,839 \times 10^{-25}$ |
| 15 | 8 | –10 | $-0.387\,449\,113\,787\,755 \times 10^{-17}$ |
| 16 | 8 | –8 | $0.139\,814\,747\,930\,240 \times 10^{-12}$ |
| 17 | 8 | –4 | $-0.171\,849\,638\,951\,521 \times 10^{-2}$ |
| 18 | 10 | –12 | $0.641\,890\,529\,513\,296 \times 10^{-21}$ |
| 19 | 10 | –8 | $0.118\,960\,578\,072\,018 \times 10^{-10}$ |
| 20 | 14 | –12 | $-0.155\,282\,762\,571\,611 \times 10^{-17}$ |
| 21 | 14 | –8 | $0.233\,907\,907\,347\,507 \times 10^{-7}$ |
| 22 | 20 | –12 | $-0.174\,093\,247\,766\,213 \times 10^{-12}$ |
| 23 | 20 | –10 | $0.377\,682\,649\,089\,149 \times 10^{-8}$ |
| 24 | 24 | –12 | $-0.516\,720\,236\,575\,302 \times 10^{-10}$ |

**Coefficients and Exponents of the Backward Equation $v_{3p}$ ($p$, $T$) for Sub Region 3p**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | 0 | –1 | $-0.982\,825\,342\,010\,366 \times 10^{-4}$ |
| 2 | 0 | 0 | $0.105\,145\,700\,850\,612 \times 10^{1}$ |
| 3 | 0 | 1 | $0.116\,033\,094\,095\,084 \times 10^{3}$ |
| 4 | 0 | 2 | $0.324\,664\,750\,281\,543 \times 10^{4}$ |
| 5 | 1 | 1 | $-0.123\,592\,348\,610\,137 \times 10^{4}$ |
| 6 | 2 | –1 | $-0.561\,403\,450\,013\,495 \times 10^{-1}$ |
| 7 | 3 | –3 | $0.856\,677\,401\,640\,869 \times 10^{-7}$ |
| 8 | 3 | 0 | $0.236\,313\,425\,393\,924 \times 10^{3}$ |
| 9 | 4 | –2 | $0.972\,503\,292\,350\,109 \times 10^{-2}$ |
| 10 | 6 | –2 | $-0.103\,001\,994\,531\,927 \times 10^{1}$ |
| 11 | 7 | –5 | $-0.149\,653\,706\,199\,162 \times 10^{-8}$ |
| 12 | 7 | –4 | $-0.215\,743\,778\,861\,592 \times 10^{-4}$ |
| 13 | 8 | –2 | $-0.834\,452\,198\,291\,445 \times 10^{1}$ |
| 14 | 10 | –3 | $0.586\,602\,660\,564\,988$ |
| 15 | 12 | –12 | $0.343\,480\,022\,104\,968 \times 10^{-25}$ |
| 16 | 12 | –6 | $0.816\,256\,095\,947\,021 \times 10^{-5}$ |
| 17 | 12 | –5 | $0.294\,985\,697\,916\,798 \times 10^{-2}$ |
| 18 | 14 | –10 | $0.711\,730\,466\,276\,584 \times 10^{-16}$ |
| 19 | 14 | –8 | $0.400\,954\,763\,806\,941 \times 10^{-9}$ |
| 20 | 14 | –3 | $0.107\,766\,027\,032\,853 \times 10^{2}$ |
| 21 | 16 | –8 | $-0.409\,449\,599\,138\,182 \times 10^{-6}$ |
| 22 | 18 | –8 | $-0.729\,121\,307\,758\,902 \times 10^{-5}$ |

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 23 | 20 | –10 | $0.677\ 107\ 970\ 938\ 909 \times 10^{-8}$ |
| 24 | 22 | –10 | $0.602\ 745\ 973\ 022\ 975 \times 10^{-7}$ |
| 25 | 24 | –12 | $-\ 0.382\ 323\ 011\ 855\ 257 \times 10^{-10}$ |
| 26 | 24 | –8 | $0.179\ 946\ 628\ 317\ 437 \times 10^{-2}$ |
| 27 | 36 | –12 | $-\ 0.345\ 042\ 834\ 640\ 005 \times 10^{-3}$ |

**Coefficients and Exponents of the Backward Equation $v_{3q}$ ($p$, $T$) for Sub Region 3q**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –12 | 10 | $-\ 0.820\ 433\ 843\ 259\ 950 \times 10^{5}$ |
| 2 | –12 | 12 | $0.473\ 271\ 518\ 461\ 586 \times 10^{11}$ |
| 3 | –10 | 6 | $-\ 0.805\ 950\ 021\ 005\ 413 \times 10^{-1}$ |
| 4 | –10 | 7 | $0.328\ 600\ 025\ 435\ 980 \times 10^{2}$ |
| 5 | –10 | 8 | $-\ 0.356\ 617\ 029\ 982\ 490 \times 10^{4}$ |
| 6 | –10 | 10 | $-\ 0.172\ 985\ 781\ 433\ 335 \times 10^{10}$ |
| 7 | –8 | 8 | $0.351\ 769\ 232\ 729\ 192 \times 10^{8}$ |
| 8 | –6 | 6 | $-\ 0.775\ 489\ 259\ 985\ 144 \times 10^{6}$ |
| 9 | –5 | 2 | $0.710\ 346\ 691\ 966\ 018 \times 10^{-4}$ |
| 10 | –5 | 5 | $0.993\ 499\ 883\ 820\ 274 \times 10^{5}$ |
| 11 | –4 | 3 | $-\ 0.642\ 094\ 171\ 904\ 570$ |
| 12 | –4 | 4 | $-\ 0.612\ 842\ 816\ 820\ 083 \times 10^{4}$ |
| 13 | –3 | 3 | $0.232\ 808\ 472\ 983\ 776 \times 10^{3}$ |
| 14 | –2 | 0 | $-\ 0.142\ 808\ 220\ 416\ 837 \times 10^{-4}$ |
| 15 | –2 | 1 | $-\ 0.643\ 596\ 060\ 678\ 456 \times 10^{-2}$ |
| 16 | –2 | 2 | $-\ 0.428\ 577\ 227\ 475\ 614 \times 10^{1}$ |
| 17 | –2 | 4 | $0.225\ 689\ 939\ 161\ 918 \times 10^{4}$ |
| 18 | –1 | 0 | $0.100\ 355\ 651\ 721\ 510 \times 10^{-2}$ |
| 19 | –1 | 1 | $0.333\ 491\ 455\ 143\ 516$ |
| 20 | –1 | 2 | $0.109\ 697\ 576\ 888\ 873 \times 10^{1}$ |
| 21 | 0 | 0 | $0.961\ 917\ 379\ 376\ 452$ |
| 22 | 1 | 0 | $-\ 0.838\ 165\ 632\ 204\ 598 \times 10^{-1}$ |
| 23 | 1 | 1 | $0.247\ 795\ 908\ 411\ 492 \times 10^{1}$ |
| 24 | 1 | 3 | $-\ 0.319\ 114\ 969\ 006\ 533 \times 10^{4}$ |

**Coefficients and Exponents of the Backward Equation $v_{3r}$ ($p$,$T$) for Sub Region 3r**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –8 | 6 | $0.144\ 165\ 955\ 660\ 863 \times 10^{-2}$ |
| 2 | –8 | 14 | $-0.701\ 438\ 599\ 628\ 258 \times 10^{13}$ |
| 3 | –3 | –3 | $-0.830\ 946\ 716\ 459\ 219 \times 10^{-16}$ |
| 4 | –3 | 3 | $0.261\ 975\ 135\ 368\ 109$ |
| 5 | –3 | 4 | $0.393\ 097\ 214\ 706\ 245 \times 10^{3}$ |
| 6 | –3 | 5 | $-\ 0.104\ 334\ 030\ 654\ 021 \times 10^{5}$ |
| 7 | –3 | 8 | $0.490\ 112\ 654\ 154\ 211 \times 10^{9}$ |
| 8 | 0 | –1 | $-\ 0.147\ 104\ 222\ 772\ 069 \times 10^{-3}$ |
| 9 | 0 | 0 | $0.103\ 602\ 748\ 043\ 408 \times 10^{1}$ |
| 10 | 0 | 1 | $0.305\ 308\ 890\ 065\ 089 \times 10^{1}$ |
| 11 | 0 | 5 | $-\ 0.399\ 745\ 276\ 971\ 264 \times 10^{7}$ |
| 12 | 3 | –6 | $0.569\ 233\ 719\ 593\ 750 \times 10^{-11}$ |
| 13 | 3 | –2 | $-\ 0.464\ 923\ 504\ 407\ 778 \times 10^{-1}$ |
| 14 | 8 | –12 | $-\ 0.535\ 400\ 396\ 512\ 906 \times 10^{-17}$ |
| 15 | 8 | –10 | $0.399\ 988\ 795\ 693\ 162 \times 10^{-12}$ |
| 16 | 8 | –8 | $-\ 0.536\ 479\ 560\ 201\ 811 \times 10^{-6}$ |
| 17 | 8 | –5 | $0.159\ 536\ 722\ 411\ 202 \times 10^{-1}$ |
| 18 | 10 | –12 | $0.270\ 303\ 248\ 860\ 217 \times 10^{-14}$ |
| 19 | 10 | –10 | $0.244\ 247\ 453\ 858\ 506 \times 10^{-7}$ |
| 20 | 10 | –8 | $-\ 0.983\ 430\ 636\ 716\ 454 \times 10^{-5}$ |
| 21 | 10 | –6 | $0.663\ 513\ 144\ 224\ 454 \times 10^{-1}$ |
| 22 | 10 | –5 | $-\ 0.993\ 456\ 957\ 845\ 006 \times 10^{1}$ |
| 23 | 10 | –4 | $0.546\ 491\ 323\ 528\ 491 \times 10^{3}$ |
| 24 | 10 | –3 | $-\ 0.143\ 365\ 406\ 393\ 758 \times 10^{5}$ |
| 25 | 10 | –2 | $0.150\ 764\ 974\ 125\ 511 \times 10^{6}$ |
| 26 | 12 | –12 | $-\ 0.337\ 209\ 709\ 340\ 105 \times 10^{-9}$ |
| 27 | 14 | –12 | $0.377\ 501\ 980\ 025\ 469 \times 10^{-8}$ |

**Coefficients and Exponents of the Backward Equation $v_{3s}$ ($p$,$T$) for Sub Region 3s**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –12 | 20 | $-\ 0.532\ 466\ 612\ 140\ 254 \times 10^{23}$ |
| 2 | –12 | 24 | $0.100\ 415\ 480\ 000\ 824 \times 10^{32}$ |
| 3 | –10 | 22 | $-\ 0.191\ 540\ 001\ 821\ 367 \times 10^{30}$ |
| 4 | –8 | 14 | $0.105\ 618\ 377\ 808\ 847 \times 10^{17}$ |
| 5 | –6 | 36 | $0.202\ 281\ 884\ 477\ 061 \times 10^{59}$ |
| 6 | –5 | 8 | $0.884\ 585\ 472\ 596\ 134 \times 10^{8}$ |
| 7 | –5 | 16 | $0.166\ 540\ 181\ 638\ 363 \times 10^{23}$ |
| 8 | –4 | 6 | $-\ 0.313\ 563\ 197\ 669\ 111 \times 10^{6}$ |
| 9 | –4 | 32 | $-\ 0.185\ 662\ 327\ 545\ 324 \times 10^{54}$ |
| 10 | –3 | 3 | $-\ 0.624\ 942\ 093\ 918\ 942 \times 10^{-1}$ |
| 11 | –3 | 8 | $-\ 0.504\ 160\ 724\ 132\ 590 \times 10^{10}$ |
| 12 | – 2 | 4 | $0.187\ 514\ 491\ 833\ 092 \times 10^{5}$ |
| 13 | –1 | 1 | $0.121\ 399\ 979\ 993\ 217 \times 10^{-2}$ |
| 14 | –1 | 2 | $0.188\ 317\ 043\ 049\ 455 \times 10^{1}$ |
| 15 | –1 | 3 | $-\ 0.167\ 073\ 503\ 962\ 060 \times 10^{4}$ |
| 16 | 0 | 0 | $0.965\ 961\ 650\ 599\ 775$ |
| 17 | 0 | 1 | $0.294\ 885\ 696\ 802\ 488 \times 10^{1}$ |

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 18 | 0 | 4 | – 0.653 915 627 346 115 × $10^{5}$ |
| 19 | 0 | 28 | 0.604 012 200 163 444 × $10^{50}$ |
| 20 | 1 | 0 | – 0.198 339 358 557 937 |
| 21 | 1 | 32 | – 0.175 984 090 163 501 × $10^{58}$ |
| 22 | 3 | 0 | 0.356 314 881 403 987 × $10^{1}$ |
| 23 | 3 | 1 | – 0.575 991 255 144 384 × $10^{3}$ |
| 24 | 3 | 2 | 0.456 213 415 338 071 × $10^{5}$ |
| 25 | 4 | 3 | – 0.109 174 044 987 829 × $10^{8}$ |
| 26 | 4 | 18 | 0.437 796 099 975 134 × $10^{34}$ |
| 27 | 4 | 24 | – 0.616 552 611 135 792 × $10^{46}$ |
| 28 | 5 | 4 | 0.193 568 768 917 797 × $10^{10}$ |
| 29 | 14 | 24 | 0.950 898 170 425 042 × $10^{54}$ |

**Coefficients and Exponents of the Backward Equation $v_{3t}$ ($p$, $T$) for Sub Region 3t**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | 0 | 0 | 0.155 287 249 586 268 × $10^{1}$ |
| 2 | 0 | 1 | 0.664 235 115 009 031 × $10^{1}$ |
| 3 | 0 | 4 | – 0.289 366 236 727 210 × $10^{4}$ |
| 4 | 0 | 12 | – 0.385 923 202 309 848 × $10^{13}$ |
| 5 | 1 | 0 | – 0.291 002 915 783 761 × $10^{1}$ |
| 6 | 1 | 10 | – 0.829 088 246 858 083 × $10^{12}$ |
| 7 | 2 | 0 | 0.176 814 899 675 218 × $10^{1}$ |
| 8 | 2 | 6 | – 0.534 686 695 713 469 × $10^{9}$ |
| 9 | 2 | 14 | 0.160 464 608 687 834 × $10^{18}$ |
| 10 | 3 | 3 | 0.196 435 366 560 186 × $10^{6}$ |
| 11 | 3 | 8 | 0.156 637 427 541 729 × $10^{13}$ |
| 12 | 4 | 0 | – 0.178 154 560 260 006 × $10^{1}$ |
| 13 | 4 | 10 | – 0.229 746 237 623 692 × $10^{16}$ |
| 14 | 7 | 3 | 0.385 659 001 648 006 × $10^{8}$ |
| 15 | 7 | 4 | 0.110 554 446 790 543 × $10^{10}$ |
| 16 | 7 | 7 | – 0.677 073 830 687 349 × $10^{14}$ |
| 17 | 7 | 20 | – 0.327 910 592 086 523 × $10^{31}$ |
| 18 | 7 | 36 | – 0.341 552 040 860 644 × $10^{51}$ |
| 19 | 10 | 10 | – 0.527 251 339 709 047 × $10^{21}$ |
| 20 | 10 | 12 | 0.245 375 640 937 055 × $10^{24}$ |
| 21 | 10 | 14 | – 0.168 776 617 209 269 × $10^{27}$ |
| 22 | 10 | 16 | 0.358 958 955 867 578 × $10^{29}$ |
| 23 | 10 | 22 | – 0.656 475 280 339 411 × $10^{36}$ |
| 24 | 18 | 18 | 0.355 286 045 512 301 × $10^{39}$ |
| 25 | 20 | 32 | 0.569 021 454 413 270 × $10^{58}$ |
| 26 | 22 | 22 | – 0.700 584 546 433 113 × $10^{48}$ |
| 27 | 22 | 36 | – 0.705 772 623 326 374 × $10^{65}$ |
| 28 | 24 | 24 | 0.166 861 176 200 148 × $10^{53}$ |
| 29 | 28 | 28 | – 0.300 475 129 680 486× $10^{61}$ |
| 30 | 32 | 22 | – 0.668 481 295 196 808× $10^{51}$ |
| 31 | 32 | 32 | 0.428 432 338 620 678 × $10^{69}$ |
| 32 | 32 | 36 | – 0.444 227 367 758 304 × $10^{72}$ |
| 33 | 36 | 36 | – 0.281 396 013 562 745 × $10^{77}$ |

1) *Numerical Consistency with the Basic Equation*

The maximum relative deviations and root-mean-square relative deviations of specific volume, calculated from the backward equations $v_3$ ($p$, $T$) for subregions 3a to 3t, from basic equation $f_3$ ($v$, $T$) in comparison with the permissible tolerances are listed in following table.

The following table also contains the maximum relative deviations and root-mean-square relative deviations of specific enthalpy, specific entropy, specific isobaric heat capacity, and speed of sound, calculated.

**Maximum Relative Deviations and Root-Mean-Square Relative Deviations of the Specific Volume, Calculated from the Backward Equations for Sub Regions 3a to 3t, and Maximum Relative Deviations of Specific Enthalpy, Specific Entropy, Specific Isobaric Heat Capacity and Speed of Sound, Calculated, from the IAPWS-IF97 Basic Equation $f_3$ ($v$,$T$)**

| *Sub region* | $\lvert\Delta v/v\rvert$ % | | $\lvert\Delta h/h\rvert$ % | | $\lvert\Delta s/s\rvert$ % | | $\lvert\Delta c_p/c_p\rvert$ % | | $\lvert\Delta w/w\rvert$ % | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *max* | *RMS* | *max* | *RMS* | *max* | *RMS* | *max* | *RMS* | *max* | *RMS* |
| 3*a* | 0.00061 | 0.00031 | 0.00018 | 0.00008 | 0.00026 | 0.00011 | 0.0016 | 0.0006 | 0.0015 | 0.0006 |
| 3*b* | 0.00064 | 0.00035 | 0.00017 | 0.00008 | 0.00016 | 0.00008 | 0.0012 | 0.0003 | 0.0008 | 0.0003 |
| 3*c* | 0.00080 | 0.00038 | 0.00026 | 0.00012 | 0.00025 | 0.00011 | 0.0059 | 0.0016 | 0.0023 | 0.0010 |
| 3*d* | 0.00059 | 0.00025 | 0.00018 | 0.00008 | 0.00014 | 0.00006 | 0.0035 | 0.0010 | 0.0012 | 0.0004 |
| 3*e* | 0.00072 | 0.00033 | 0.00018 | 0.00009 | 0.00014 | 0.00007 | 0.0017 | 0.0005 | 0.0006 | 0.0002 |
| 3*f* | 0.00068 | 0.00020 | 0.00018 | 0.00005 | 0.00013 | 0.00004 | 0.0015 | 0.0003 | 0.0002 | 0.0001 |
| 3*g* | 0.00047 | 0.00016 | 0.00014 | 0.00005 | 0.00011 | 0.00004 | 0.0032 | 0.0011 | 0.0010 | 0.0003 |
| 3*h* | 0.00085 | 0.00044 | 0.00022 | 0.00012 | 0.00017 | 0.00009 | 0.0066 | 0.0018 | 0.0006 | 0.0002 |
| 3*i* | 0.00067 | 0.00028 | 0.00018 | 0.00008 | 0.00013 | 0.00006 | 0.0019 | 0.0006 | 0.0002 | 0.0001 |
| 3*j* | 0.00034 | 0.00019 | 0.00009 | 0.00005 | 0.00007 | 0.00004 | 0.0020 | 0.0006 | 0.0002 | 0.0001 |
| 3*k* | 0.00034 | 0.00012 | 0.00008 | 0.00003 | 0.00007 | 0.00002 | 0.0018 | 0.0003 | 0.0002 | 0.0001 |
| 3*l* | 0.00033 | 0.00019 | 0.00010 | 0.00006 | 0.00008 | 0.00005 | 0.0035 | 0.0015 | 0.0008 | 0.0004 |
| 3*m* | 0.00057 | 0.00031 | 0.00015 | 0.00009 | 0.00011 | 0.00006 | 0.0062 | 0.0030 | 0.0006 | 0.0002 |
| 3*n* | 0.00064 | 0.00029 | 0.00017 | 0.00008 | 0.00012 | 0.00003 | 0.0050 | 0.0013 | 0.0002 | 0.0001 |
| 3*o* | 0.00031 | 0.00015 | 0.00008 | 0.00004 | 0.00006 | 0.00005 | 0.0007 | 0.0002 | 0.0001 | 0.0001 |
| 3*p* | 0.00044 | 0.00022 | 0.00012 | 0.00006 | 0.00009 | 0.00005 | 0.0026 | 0.0010 | 0.0002 | 0.0001 |
| 3*q* | 0.00036 | 0.00018 | 0.00012 | 0.00006 | 0.00009 | 0.00002 | 0.0040 | 0.0016 | 0.0010 | 0.0005 |
| 3*r* | 0.00037 | 0.00007 | 0.00010 | 0.00002 | 0.00008 | 0.00004 | 0.0030 | 0.0004 | 0.0002 | 0.0001 |
| 3*s* | 0.00030 | 0.00016 | 0.00010 | 0.00005 | 0.00007 | 0.00008 | 0.0033 | 0.0015 | 0.0009 | 0.0005 |
| 3*t* | 0.00095 | 0.00045 | 0.00022 | 0.00010 | 0.00018 | 0.000 | 0.0046 | 0.0015 | 0.0004 | 0.0002 |
| Permissible Tolerance | 0.001 | | 0.001 | | 0.001 | | 0.001 | 0.01 | 0.01 | |

f) Backward Equation $p(h, s)$

The backward equation $p_{3a}$ ($h$,$s$) for sub region 3a has the following dimensionless form:

$$\frac{p_{3a}(h,s)}{p^*} = \pi_{3a}(\eta,\sigma) = \sum_{i=1}^{33} n_i (\eta - 1.01)^{I_i} (\sigma - 0.750)^{J_i} \quad ...(45)$$

where $\pi = p/p^*$, $\eta = h/h^*$ and $\sigma = s/s^*$ with $p^* = 99$ MPa, $h^* = 2300$ kJ kg$^{-1}$ and $s^* = 4.4$ kJ kg$^{-1}$ K$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Eq. (45) are listed in following table:

**Numerical Values of the Coefficients and Exponents of the Backward Equation $p_{3a}$($h$,$s$) for Sub-Region 3a in its Dimensionless form, Equation (45)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | 0 | 0 | $0.770\,889\,828\,326\,934 \times 10^1$ |
| 2 | 0 | 1 | $-\,0.260\,835\,009128\,688 \times 10^2$ |
| 3 | 0 | 5 | $0.267\,416\,218\,930\,389 \times 10^3$ |
| 4 | 1 | 0 | $-\,0.172\,221\,089\,496\,844 \times 10^2$ |

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 5 | 1 | 3 | – 0.293 542 332 145 970 × $10^3$ |
| 6 | 1 | 4 | 0.614 135 601 882 478 × $10^3$ |
| 7 | 1 | 8 | – 0.610 562 757 725 674 × $10^5$ |
| 8 | 1 | 14 | – 0.651 272 251 118 219 × $10^8$ |
| 9 | 2 | 6 | 0.735 919 313 521 937 × $10^5$ |
| 10 | 2 | 16 | – 0.116 646 505 914 191 × $10^{11}$ |
| 11 | 3 | 0 | 0.355 267 086 434 461 × $10^2$ |
| 12 | 3 | 2 | – 0.596 144 543 825 955 × $10^3$ |
| 13 | 3 | 3 | – 0.475 842 430 145 708 × $10^3$ |
| 14 | 4 | 0 | 0.696 781 965 359 503 × $10^2$ |
| 15 | 4 | 1 | 0.335 674 250 377 312 × $10^3$ |
| 16 | 4 | 4 | 0.250 526 809 130 882 × $10^5$ |
| 17 | 4 | 5 | 0.146 997 380 630 766 × $10^6$ |
| 18 | 5 | 28 | 0.538 069 315 091 534 × $10^{20}$ |
| 19 | 6 | 28 | 0.143 619 827 291 346 × $10^{22}$ |
| 20 | 7 | 24 | 0.364 985 866 165 994 × $10^{20}$ |
| 21 | 8 | 1 | – 0.254 741 561 156 775 × $10^4$ |
| 22 | 10 | 32 | 0.240 120 197 096 563 × $10^{28}$ |
| 23 | 10 | 36 | – 0.393 847 464 679 496 × $10^{30}$ |
| 24 | 14 | 22 | 0.147 073 407 024 852 × $10^{25}$ |
| 25 | 18 | 28 | – 0.426 391 250 432 059 × $10^{32}$ |
| 26 | 20 | 36 | 0.194 509 340 621 077 × $10^{39}$ |
| 27 | 22 | 16 | 0.666 212 132 114 896 × $10^{24}$ |
| 28 | 22 | 28 | 0.706 777 016 552 858 × $10^{34}$ |
| 29 | 24 | 36 | 0.175 563 621 975 576 × $10^{42}$ |
| 30 | 28 | 16 | 0.108 408 607 429 124 × $10^{29}$ |
| 31 | 28 | 36 | 0.730 872 705 175 151 × $10^{44}$ |
| 32 | 32 | 10 | 0.159 145 847 398 870 × $10^{25}$ |
| 33 | 32 | 28 | 0.377 121 605 943 324 × $10^{41}$ |

The backward equation $p_{3b}(h,s)$ for sub region 3b has the following dimensionless form:

$$\frac{p^*}{p_{3b}(h,s)} = \frac{1}{\pi_{3b}}(\eta,\sigma) = \sum_{i=1}^{35} n_i (\eta - 0.681)^{I_i} (\sigma - 0.792)^{J_i} \quad ...(46)$$

where $\pi = p/p^*$, $\eta = h/h^*$ and $\sigma = s/s^*$ with $p^* = 16.6$ MPa, $h^* = 2800$ kJ kg$^{-1}$ and $s^* = 5.3$ kJ kg$^{-1}$ K$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Eq. (46) are listed in following table:

**Numerical Values of the Coefficients and Exponents of the Backward Equation $p_{3a}(h,s)$ for Sub-Region 3b in its Dimensionless form, Equation (46)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | –12 | 2 | 0.125 244 360 717 979 × $10^{-12}$ |
| 2 | –12 | 10 | – 0.126 599 322 553 713 × $10^{-1}$ |
| 3 | –12 | 12 | 0.506 878 030 140 626 × $10^1$ |
| 4 | –12 | 14 | 0.317 847 171 154 202 × $10^2$ |
| 5 | –12 | 20 | – 0.391 041 161 399 932 × $10^6$ |
| 6 | –10 | 2 | – 0.975 733 406 392 044 × $10^{-10}$ |
| 7 | –10 | 10 | – 0.186 312 419 488 279× $10^2$ |
| 8 | –10 | 14 | 0.510 973 543 414 101 × $10^3$ |
| 9 | –10 | 18 | 0.373 847 005 822 362 × $10^6$ |
| 10 | –8 | 2 | 0.299 804 024 666 572 × $10^{-7}$ |
| 11 | –8 | 8 | 0.200 544 393 820 342 × $10^2$ |
| 12 | – 6 | 2 | – 0.498 030 487 662 829 × $10^{-5}$ |
| 13 | –6 | 6 | – 0.102 301 806 360 030 × $10^2$ |
| 14 | –6 | 7 | 0.552 819 126 990 325 × $10^2$ |
| 15 | –6 | 8 | – 0.206 211 367 510 878 × $10^3$ |
| 16 | –5 | 10 | – 0.794 012 232 324 823 × $10^4$ |
| 17 | –4 | 4 | 0.782 248 472 028 153 × $10^1$ |
| 18 | –4 | 5 | – 0.586 544 326 902 468 × $10^2$ |
| 19 | –4 | 8 | 0.355 073 647 696 481 × $10^4$ |
| 20 | –3 | 1 | – 0.115 303 107 290 162 × $10^{-3}$ |
| 21 | –3 | 3 | – 0.175 092 403 171 802 × $10^1$ |
| 22 | –3 | 5 | 0.257 981 687 748 160 × $10^3$ |
| 23 | –3 | 6 | – 0.727 048 374 179 467 × $10^3$ |
| 24 | –2 | 0 | 0.121 644 822 609 198 × $10^{-3}$ |
| 25 | –2 | 1 | 0.393 137 871 762 692 × $10^{-1}$ |
| 26 | –1 | 0 | 0.704 181 005 909 296 × $10^{-2}$ |
| 27 | 0 | 3 | – 0.829 108 200 698 110 × $10^2$ |
| 28 | 2 | 0 | – 0.265 178 818 131 250 |
| 29 | 2 | 1 | 0.137 531 682 453 991 × $10^2$ |
| 30 | 5 | 0 | – 0.522 394 090 753 046 × $10^2$ |
| 31 | 6 | 1 | 0.240 556 298 941 048 × $10^4$ |
| 32 | 8 | 1 | – 0.227 361 631 268 929 × $10^5$ |
| 33 | 10 | 1 | 0.890 746 343 932 567 × $10^5$ |
| 34 | 14 | 3 | – 0.239 234 565 822 486 × $10^8$ |
| 35 | 14 | 7 | 0.568 795 808 129 714 × $10^{10}$ |

1) *Numerical Consistency with the Basic Equation*

The maximum relative deviations and root-mean-square relative deviations between the calculated pressure, Equations (45) and (46) and the basic equation $f_3(v,T)$ together with the permissible differences are listed in following table:

**Maximum Differences and Root-Mean-Square Differences Between the Pressure Calculated from Equations (45) and (46) to the IAPWS-IF97 Basic Equation $f_3$ (v, T) and Related Permissible Values**

| *Region/Sub region* | Equation | $\lvert\Delta p/p\rvert_{tol}$ | $\lvert\Delta p/p\rvert_{max}$ | $\lvert\Delta p/p\rvert_{RMS}$ |
|---|---|---|---|---|
| 3*a* | (45) | 0.01 % | 0.0070 % | 0.0030 % |
| 3*b* | (46) | 0.01 % | 0.0084 % | 0.0036 % |

g) Backward Function $T(h,s)$

Calculate the temperature as a function of enthalpy and entropy by using following function:

$$T_3\,(h,s) = T_3\,(p_3\,(h,s),h) \qquad \ldots (47)$$

1) *Numerical Consistency with the Basic Equation*

The maximum temperature differences and related root-mean-square differences between the calculated temperature and the basic equation $f_3$ $(v,T)$ together with the permissible differences are listed in following Table. The temperature differences were calculated as follows for sub regions 3a and 3b:

$$\Delta T = T_3\,[p_3\,(h_3,s_3),h_3] - T \qquad ...(48)$$

**Maximum Differences and Root-Mean-Square Differences of the Temperature Calculated to the Basic Equation $f_3$ (v, T) and Related Permissible Values**

| *Region/Sub region* | $\lvert\Delta T\rvert_{tol}$ | $\lvert\Delta T\rvert_{max}$ | $\lvert\Delta T\rvert_{RMS}$ |
|---|---|---|---|
| 3*a* | 25 mK | 23.7 mK | 10.5 mK |
| 3*b* | 25 mK | 22.4 mK | 9.9 mK |

h) Backward Function

Calculate the specific volume as a function of enthalpy and entropy by using following function:

$$v_3\,(h,s) = v_3\,(p_3\,(h,s),s) \qquad \ldots (49)$$

1) *Numerical Consistency with the Basic Equation*

The maximum relative deviations and related root-mean-square relative deviations between the calculated specific volume and the IAPWS-IF97 basic equation $f_3$ $(v,T)$ together with the permissible differences are listed in following Table. The specific volume relative deviations for sub regions 3a and 3b were calculated using the relation.

$$\Delta v = (v_3\,[p_3\,(h_3,s_3),s_3] - v)/v \qquad \ldots (50)$$

**Maximum Relative Differences and Root-Mean-Square Relative Differences Between Calculated Specific Volume and the IAPWSIF97 Basic Equation $f_3$ (v, T), and Related Permissible Values**

| *Region/Sub region* | $\lvert\Delta v/v\rvert_{tol}$ | $\lvert\Delta v/v\rvert_{max}$ | $\lvert\Delta v/v\rvert_{RMS}$ |
|---|---|---|---|
| 3*a* | 0.01 % | 0.0070 % | 0.0030 % |
| 3*b* | 0.01 % | 0.0084 % | 0.0036 % |

**5.10.6** *Equations for Region 4*

This section contains all details relevant for the use of the equations for region 4 of IAPWS-IF97 (saturation line). Information about the consistency of the basic equation for this region, the saturation-pressure equation, and the basic equations of regions 1 to 3 at the corresponding region boundaries is summarized in clause **5.6**. The estimates of uncertainty of the saturation pressure can be found in clause **5.7**.

The equation for describing the saturation line is an implicit quadratic equation which can be directly solved with regard to both saturation pressure $p_s$ and saturation temperature $T_s$. This equation peruses,

$$\beta^2\vartheta^2 + n_1\beta^2\vartheta + n_2\beta^2 + n_3\beta\vartheta^2 + n_4\beta\vartheta + n_5\beta + n_6\vartheta^2 + n_7\vartheta + n_8 = 0 \qquad ...(51)$$

where

$$\beta = (p_s/p^*)^{1/4} \qquad ... (51a)$$

and

$$\vartheta = T_s/T^* + n_9/((T_s - T^*) - n_{10}) \qquad ...(51b)$$

with $p^*$ = 1 MPa, $T^*$ = 1 K; for the coefficients $n_1$ to $n_{10}$ *see* the Table in clause **5.10.6.1**.

**5.10. 6.1** *Basic equation*

The solution of Equation (51) with regard to saturation pressure is as follows:

$$\frac{p_s}{p^*} = \left[\frac{2C}{-B + \left(B^2 - 4AC\right)^{1/2}}\right]^4 \qquad ...(52)$$

where $p^*$ = 1 MPa and

$$A = \vartheta^2 + n_1\vartheta + n_2$$
$$B = n_3\vartheta^2 + n_4\vartheta + n_5$$
$$C = n_6\vartheta^2 + n_7\vartheta + n_8$$

with according to Eq. (51b). The coefficients of Eq. (52) are listed in following table:

**Numerical Values of the Coefficients of the Dimensionless Saturation Equations, Equations (51) to (53)**

| *i* | $n_i$ |
|---|---|
| 1 | $0.116\,705\,214\,527\,67 \times 10^4$ |
| 2 | $-0.724\,213\,167\,032\,06 \times 10^6$ |
| 3 | $-0.170\,738\,469\,400\,92 \times 10^2$ |
| 4 | $0.120\,208\,247\,024\,70 \times 10^5$ |
| 5 | $-0.323\,255\,503\,223\,33 \times 10^7$ |
| 6 | $0.149\,151\,086\,135\,30 \times 10^2$ |
| 7 | $-0.482\,326\,573\,615\,91 \times 10^4$ |
| 8 | $0.405\,113\,405\,420\,57 \times 10^6$ |
| 9 | $-0.238\,555\,575\,678\,49$ |
| 10 | $0.650\,175\,348\,447\,98 \times 10^3$ |

Equations (51) to (53) reproduce exactly the $p - T$ values at the triple point according to Eq. (9), at the normal boiling point [*see* 11, annex C] and at the critical point according to Equations (2) and (3).

1) *Range of Validity*

Equation (52) is valid along the entire vapor-liquid saturation line from the triple-point temperature $T_t$ to the critical temperature $T_c$ and can be simply extrapolated to 273.15 K so that it covers the temperature range

$$273.15 \text{ K} \leq T \leq 647.096 \text{ K}$$

**5.10.6.2** *Backward equations*

a) The Saturation-Temperature Equation

The saturation-temperature solution of Equation (51) peruses

$$\frac{T_s}{T^*} = \frac{n_{10} + D - \left[(n_{10} + D)^2 - 4(n_9 + n_{10}D)\right]^{1/2}}{2} \quad ...(53)$$

Where $T^*$ = 1 K and

$$\mathrm{D} = \frac{2G}{-F - \left(F^2 - 4EG\right)^{1/2}}$$

with

$$E = \beta^2 + n_3\beta + n_6$$
$$F = n_1\beta^2 + n_4\beta + n_7$$
$$G = n_2\beta^2 + n_5\beta + n_8$$

and according to Equation (51a). The coefficients $n_i$ of Equation (53) are listed in above table.

1) *Range of Validity*

Equation (53) has the same range of validity as Equation (52), which means that it covers the vapour-liquid saturation line according to the pressure range.

$$611.213 \text{ Pa} \leq p \leq 22.064 \text{ MPa}$$

The value of 611.213 corresponds to the pressure when Equation (53) is extrapolated to 273.15 K.

2) *Consistency with the Basic Equation*

Since the saturation-pressure equation, Equation (52), and the saturation-temperature equation, Equation (53), have been derived from the same implicit equation, Equation (51), for describing the saturation line, both Equation (52) and Equation (53) are completely consistent with each other.

b) Backward Equation $T_s$ $(h,s)$

In modeling power cycles and steam turbines, thermodynamic properties as a function of the variables $(h,s)$ are required in the two-phase (wet steam) region. The important region for steam turbine calculations is the range $s \geq s''$ (623.15 K), *see* the following Fig, where the saturation temperature is less than 623.15 K and the two-phase region is located between regions 1 and 2. In this region, the calculation of saturation properties from a given $h$ and $s$ requires iteration using the basic equations $g_1(p,T)$ and $g_2(p,T)$ and the saturation-pressure equation $p_s(T)$. In order to avoid such iterations, below provides an equation $T_s(h,s)$ for the two-phase region.

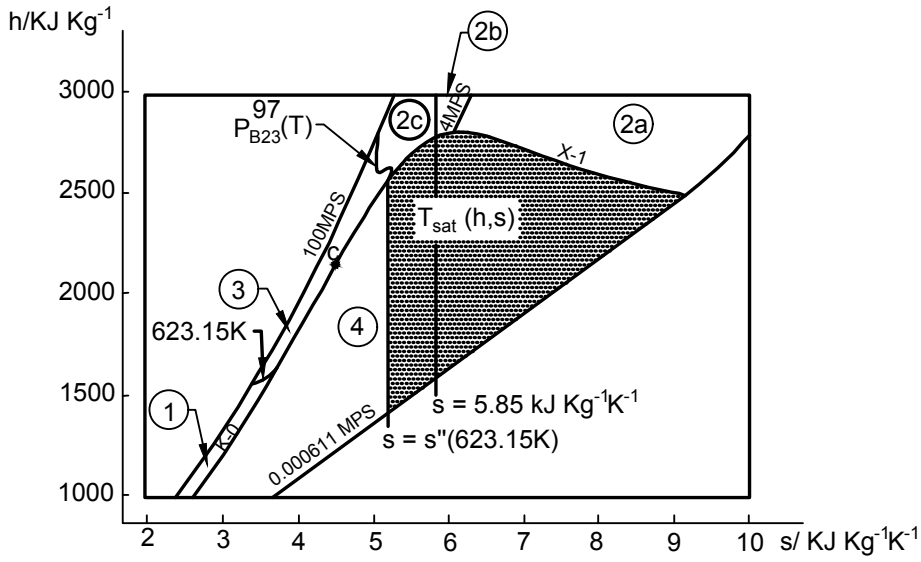



FIG. 5-7 REGIONS AND SUB-REGIONS AND THE BACKWARD EQUATION $T_s(h, s)$

The backward equation $T_s(h,s)$ for the two-phase region has the following dimensionless form:

$$\frac{T_s(h,s)}{T^*} = \theta_s(\eta,\sigma) = \sum_{i=1}^{36} n_i (\eta - 0.119)^{I_i} (\sigma - 1.07)^{J_i} \quad ...(54)$$

Where $\theta = T/T^*$, $\eta = h/h^*$ and $\sigma = s/s^*$ with $T^* = 550$ K, $h^* = 2800$ kJ kg$^{-1}$ and $s^* = 9.2$ kJ kg$^{-1}$ K$^{-1}$. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Eq. (54) are listed in following table

**Numerical Values of the Coefficients and Exponents of the Equation $T_s(h,s)$ in its Dimensionless form, Equation (54)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | 0 | 0 | 0.179 882 673 606 601 |
| 2 | 0 | 3 | −0.267 507 455 199 603 |
| 3 | 0 | 12 | 0.116 276 722 612 600 × $10^1$ |
| 4 | 1 | 0 | 0.147 545 428 713 616 |
| 5 | 1 | 1 | −0.512 871 635 973 248 |
| 6 | 1 | 2 | 0.421 333 567 697 984 |
| 7 | 1 | 5 | 0.563 749 522 189 870 |
| 8 | 2 | 0 | 0.429 274 443 819 153 |
| 9 | 2 | 5 | −0.335 704 552 142 140 × $10^1$ |
| 10 | 2 | 8 | 0.108 890 916 499 278 × $10^2$ |
| 11 | 3 | 0 | −0.248 483 390 456 012 |
| 12 | 3 | 2 | 0.304 153 221 906 390 |
| 13 | 3 | 3 | −0.494 819 763 939 905 |
| 14 | 3 | 4 | 0.107 551 674 933 261 × $10^1$ |
| 15 | 4 | 0 | 0.733 888 415 457 688 × $10^{-1}$ |
| 16 | 4 | 1 | 0.140 170 545 411 085 × $10^{-1}$ |
| 17 | 5 | 1 | −0.106 110 975 998 808 |
| 18 | 5 | 2 | 0.168 324 361 811 875 × $10^{-1}$ |
| 19 | 5 | 4 | 0.125 028 363 714 877 × $10^1$ |
| 20 | 5 | 16 | 0.101 316 840 309 509 × $10^4$ |
| 21 | 6 | 6 | −0.151 791 558 000 712 × $10^1$ |
| 22 | 6 | 8 | 0.524 277 865 990 866 × $10^2$ |
| 23 | 6 | 22 | 0.230 495 545 563 912 × $10^5$ |
| 24 | 8 | 1 | 0.249 459 806 365 456 × $10^{-1}$ |
| 25 | 10 | 20 | 0.210 796 467 412 137 × $10^7$ |
| 26 | 10 | 36 | 0.366 836 848 613 065 × $10^9$ |
| 27 | 12 | 24 | −0.144 814 105 365 163 × $10^9$ |
| 28 | 14 | 1 | −0.179276373003 590 × $10^{-2}$ |
| 29 | 14 | 28 | 0.489 955 602 100 459 × $10^{10}$ |
| 30 | 16 | 12 | 0.471 262 212 070 518 × $10^3$ |
| 31 | 16 | 32 | −0.829 294 390 198 652 × $10^{11}$ |
| 32 | 18 | 14 | −0.171 545 662 263 191 × $10^4$ |
| 33 | 18 | 22 | 0.355 777 682 973 575 × $10^7$ |
| 34 | 18 | 36 | 0.586 062 760 258 436 × $10^{12}$ |
| 35 | 20 | 24 | −0.129 887 635 078 195 × $10^8$ |
| 36 | 28 | 36 | 0.317 247 449 371 057 × $10^{11}$ |

1) *Range of Validity*

The range of validity of the backward equation $T_s(h,s)$ is the two phase region for $s \geq s''$ (623.15 K) with $s''$ (623.15 K) = 5.210 887 825 kJ kg$^{-1}$ K$^{-1}$.

The corresponding temperature range is 273.15 K ≤ T ≤ 623.15 K.

2) *Numerical Consistency with the Saturation-Temperature Equation*

The maximum deviations and related root-mean-square differences between the calculated temperature, Equation (54), and the saturation-temperature equation were calculated as follows:

$$|\Delta T_s|_{max} = |T_s(h,s) - T_s(\mathrm{p})|_{max} \quad \ldots (55)$$

The maximum differences are listed in following table:

**Maximum Differences and Related Root-Mean-Square Differences Between the Temperature Calculated from Equation (55) and from the Saturation-Temperature Equation $T_s(p)$**

| *Entropy Range* | $\|\Delta T\|_{tol}$ | $\|\Delta T\|_{max}$ | $\|\Delta T\|_{RMS}$ |
|---|---|---|---|
| $s \geq 5.85$ *kJ kg*$^{-1}$ K$^{-1}$ | 10 mK | 0.67 mK | 0.33 mK |
| $s < 5.85$ *kJ kg*$^{-1}$ K$^{-1}$ | 25 mK | 0.86 mK | 0.45 mK |

c) Backward Function

Calculate the saturation pressure as a function of enthalpy and entropy by using following function:

$$p_s(h,s) = p_s(T_s(h,s)) \quad ...(56)$$

1) *Numerical Consistency with the Saturation-Pressure Equation*

The maximum relative deviations and root-mean-square relative deviations between the calculated pressure $p_s(h,s)$ and the IAPWS-IF97 saturation-pressure equation $p_s(T)$ were calculated as follows:

$$\left|\frac{\Delta p_s}{p_s}\right|_{max} = \left|\frac{p_s(T_s(h,s)) - p_s(T)}{p_s(T)}\right|_{max} \quad ...(57)$$

The resulting maximum relative deviations and root-mean-square relative deviations are listed in following table:

**Maximum Relative Deviations and Root-Mean-Square Relative Deviations Between the Pressure $p_s(h,s)$ and the Saturation-Pressure Equation $p_s(T)$**

| *Entropy Range* | $\left\lvert\frac{\Delta p}{p}\right\rvert_{tol}$ | $\left\lvert\frac{\Delta p}{p}\right\rvert_{max}$ | $\left\lvert\frac{\Delta p}{p}\right\rvert_{RMS}$ |
|---|---|---|---|
| $s \geq 5.85$ kJ kg$^{-1}$ K$^{-1}$ | 0.0035 % | 0.0029 % | 0.0012 % |
| $s < 5.85$ kJ kg$^{-1}$ K$^{-1}$ | 0.0088 % | 0.0034 % | 0.0013 % |

The following Table shows that the maximum relative deviations are smaller than the tolerances. Therefore, the accuracy of the temperature calculated by the equation $T_s(h,s)$, Eq. (57), is sufficient for calculating pressure as a function of $h$ and $s$.

d) Backward Function $x\,(h,s)$

Calculate the vapour fraction as a function of enthalpy and entropy by using following relation:

$$x = \frac{(h - h')}{(h'' - h')} \qquad \ldots (58)$$

where $h' = h_1\ \{p_s\ [T_s(h,s)], T_s\ (h,s)\}$ and $h'' = h_2\ \{p_s[T_s(h,s)], T_s\ (h,s)\}$

1) *Numerical Consistency with Basic Equation*

The maximum deviations and related root-mean-square deviations between the calculated vapour fraction $x(h,s)$ and vapor fractions calculated from the IAPWS-IF97 basic equations $g_1(p,T)$ and $g_2(p,T)$ were calculated as follows:

$$\left|\Delta x\right|_{max} = \left|x(h,s) - x\right|_{max} \text{with } x$$

$$= \frac{h - h_1\left(p_s\left(T_s(h,s)\right), T_s(h,s)\right)}{h_2\left(p_s\left(T_s(h,s)\right), T_s(h,s)\right) - h_1\left(p_s\left(T_s(h,s)\right), T_s(h,s)\right)} \qquad \ldots (59)$$

The maximum deviations and root-mean-square deviations are listed in following table:

**Maximum Differences of Vapour Fraction $x(h,s)$ from the Basic Equations $g_1(p,T)$ and $g_2(p,T)$**

| *Entropy Range* | $\lvert\Delta x\rvert_{max}$ | $\lvert\Delta x\rvert_{RMS}$ |
|---|---|---|
| $s \geq 5.85\ kJ\ kg^{-1}\ K^{-1}$ | $0.64 \times 10^{-6}$ | $0.25 \times 10^{-6}$ |
| $s < 5.85\ kJ\ kg^{-1}\ K^{-1}$ | $4.40 \times 10^{-6}$ | $0.57 \times 10^{-6}$ |

The above table shows that the vapour fraction $x(h,s)$ can be calculated to 5 digits of accuracy. Therefore, the accuracy of temperature calculated by the equation $T_s(h,s)$, Eq. (59), is sufficient for calculating vapour fraction as a function of $h$ and $s$.

**5.10.7** *Equations for Region 5*

This section contains all details relevant for the use of the equations for region 5 of IAPWS-IF97. Information about the consistency at the boundary between regions 2 and 5 is summarized in 5.6. The estimates of uncertainty of the most relevant properties can be found in 5.7.

The basic equation for this high-temperature region is a fundamental equation for the specific Gibbs free energy g. This equation is expressed in dimensionless form, $\gamma = g/(RT)$, and is separated into two parts, an ideal-gas part $\gamma^o$ and a residual part $\gamma^r$, so that

$$\frac{g_5(p,T)}{RT} = \gamma(\pi,\tau) = \gamma^o(\pi,\tau) + \gamma^r(\pi,\tau) \qquad \ldots (60)$$

Where $\pi = p/p^*$ and $\tau = T^*/T$ with $R$ given by Eq. (1).

The equation for the ideal-gas part $\gamma^o$ of the dimensionless Gibbs free energy peruses.

$$\gamma^o = \ln \pi + \sum_{i=1}^{6} n_i^o \tau^{J_i^o} \qquad \ldots (61)$$

Where $\pi = p/p^*$ and $\tau = T^*/T$ with $p^* = 1$ MPa and $T^* = 1\,000$ K. The coefficients $n_1^0$ and $n_2^0$ were adjusted in such a way that the values for the specific internal energy and specific entropy in the ideal-gas state relate to Eq. (8). The following Table contains the coefficients $n_i^o$ andexponents $J_i^o$ of Eq. (61).

**Numerical Values of the Coefficients and Exponents of the Ideal-Gas Part $\gamma^o$ of the Dimensionless Gibbs free Energy for Region 5, Eq. (61)**

| $i$ | $J_i^o$ | $n_i^o$ |
|---|---|---|
| 1 | 0 | $-0.131\,799\,836\,742\,01 \times 10^2$ |
| 2 | 1 | $0.685\,408\,416\,344\,34 \times 10^1$ |
| 3 | −3 | $-0.248\,051\,489\,334\,66 \times 10^{-1}$ |
| 4 | −2 | 0.369 015 349 803 33 |
| 5 | −1 | $-0.311\,613\,182\,139\,25 \times 10^1$ |
| 6 | 2 | −0.329 616 265 389 17 |

The form of the residual part $\gamma^r$ of the dimensionless Gibbs free energy is as follows:

$$\gamma^r = \sum_{i=1}^{6} n_i \pi^{I_i} \tau^{J_i} \qquad \ldots (62)$$

Where $\pi = p/p^*$ and $\tau = T^*/T$ with $p^* = 1$ MPa and $T^* = 1\,000$ K. The coefficients $n_i$ and exponents $I_i$ and $J_i$ of Eq. (62) are listed in following table:

**Numerical Values of the Coefficients and Exponents of the Residual part $\gamma^r$ of the Dimensionless Gibbs free Energy for Region 5, Eq. (62)**

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 1 | 1 | 1 | $0.157\,364\,048\,552\,59 \times 10^{-2}$ |
| 2 | 1 | 2 | $0.901\,537\,616\,739\,44 \times 10^{-3}$ |
| 3 | 1 | 3 | $-0.502\,700\,776\,776\,48 \times 10^{-2}$ |

| $i$ | $I_i$ | $J_i$ | $n_i$ |
|---|---|---|---|
| 4 | 2 | 3 | $0.224\,400\,374\,094\,85 \times 10^{-5}$ |
| 5 | 2 | 9 | $-0.411\,632\,754\,534\,71 \times 10^{-5}$ |
| 6 | 3 | 7 | $4\,548\,229\,55 \times 10^{-7}$ |

1) *Range of Validity*

Equation (60) covers region 5 of IAPWS-IF97 defined by the following temperature and pressure range:

$$1\,073.15\ \text{K} \le T \le 2\,273.15\ \text{K}\quad 0 < p \le 50\ \text{MPa}$$

Eq. (60) is only valid for pure un-dissociated water; any dissociation will have to be taken into account separately.

All thermodynamic properties can be derived from Eq. (60) by using the appropriate combinations of the ideal-gas part $\gamma^o$, Eq. (61), and the residual part $\gamma^r$, Eq. (62), of the dimensionless Gibbs free energy and their derivatives. Relations between the relevant thermodynamic properties and $\gamma^o$ and $\gamma^r$ and their derivatives are summarized in following table:

**Relations of Thermodynamic Properties to the Ideal-Gas Part $\gamma^o$ and the Residual Part $\gamma^r$ of the Dimensionless Gibbs free Energy and their Derivatives[a] when Using Eq. (60)**

| *Property* | *Relation* |
|---|---|
| Specific Volume<br>$v = (\partial g/\partial p)_T$ | $v(\pi,\tau)\dfrac{p}{RT} = \pi\left(\gamma_\pi^o + \gamma_\pi^r\right)$ |
| Specific Internal Energy<br>$u = g - T(\partial g/\partial T)_p - p(\partial g/\partial p)_T$ | $\dfrac{u(\pi,\tau)}{RT} = \tau\left(\gamma_\tau^o + \gamma_\tau^r\right) - \pi\left(\gamma_\pi^o + \gamma_\pi^r\right)$ |
| Specific Entropy<br>$s = -(\partial g/\partial p)_p$ | $\dfrac{s(\pi,\tau)}{R} = \tau\left(\gamma_\tau^o + \gamma_\tau^r\right) - \left(\gamma^o + \gamma^r\right)$ |
| Specific Enthalpy<br>$h = g - T(\partial g/\partial T)_p$ | $\dfrac{h(\pi,\tau)}{RT} = \tau\left(\gamma_\tau^o + \gamma_\tau^r\right)$ |
| Specific isobaric heat capacity<br>$c_p = (\partial h/\partial T)_p$ | $\dfrac{c_p(\pi,\tau)}{R} = -\tau^2\left(\gamma_{\tau\tau}^o + \gamma_{\tau\tau}^r\right)$ |
| Specific isochoric heat capacity<br>$c_v = (\partial u/\partial T)_v$ | $\dfrac{c_v(\pi,\tau)}{R} = -\tau^2\left(\gamma_{\tau\tau}^o + \gamma_{\tau\tau}^r\right) - \dfrac{\left(1+\pi\gamma_\pi^r - \tau\pi\gamma_{\pi\tau}^r\right)^2}{1-\pi^2\gamma_{\pi\pi}^r}$ |
| Speed of sound<br>$w = v[-(\partial p/\partial v)_s]^{1/2}$ | $\dfrac{w^2(\pi,\tau)}{RT} = \dfrac{1+2\pi\gamma_\pi^r + \pi^2\gamma_\pi^{r2}}{\left(1-\pi^2\gamma_{\pi\pi}^r\right) + \dfrac{\left(1+\pi\gamma_\pi^r - \tau\pi\gamma_{\pi\tau}^r\right)^2}{\tau^2(\gamma_{\tau\tau}^o + \gamma_{\tau\tau}^{r)}}}$ |

[a] $\gamma_\pi^r = \left[\dfrac{\partial\gamma^r}{\partial\pi}\right]_\tau$, $\gamma_{\pi\pi}^r = \left[\dfrac{\partial^2\gamma^r}{\partial\pi^2}\right]_\tau$, $\gamma_\tau^r = \left[\dfrac{\partial\gamma^r}{\partial\tau}\right]_\pi$, $\gamma_{\tau\tau}^r = \left[\dfrac{\partial^2\gamma^r}{\partial\tau^2}\right]_\pi$, $\gamma_{\pi\tau}^r = \left[\dfrac{\partial^2\gamma^r}{\partial\pi\partial\tau}\right]$,

$\gamma_\tau^o = \left[\dfrac{\partial\gamma^o}{\partial\tau}\right]_\pi$, $\gamma_{\tau\tau}^o = \left[\dfrac{\partial^2\gamma^o}{\partial\tau^2}\right]_\pi$

All required derivatives of the ideal-gas part and of the residual part of the dimensionless Gibbs free energy are explicitly given in the following tables below.

**The Ideal-Gas Part $\gamma^o$ of the Dimensionless Gibbs free Energy and its Derivatives[a] According to Equation (61)**

| |
|---|
| $\gamma^o = \ln \pi + \sum_{i=1}^{6} n_i^o \tau^{J_i^o}$ |
| $\gamma_\pi^o = \frac{1}{\pi} + 0$ |
| $\gamma_{\pi\pi}^o = -\frac{1}{\pi^2} + 0$ |
| $\gamma_\tau^o = 0 + \sum_{i=1}^{6} n_i^o J_i^o \tau^{J_i^o - 1}$ |
| $\gamma_{\tau\tau}^o = 0 + \sum_{i=1}^{6} n_i^o J_i^o \left(J_i^o - 1\right) \tau^{J_i^o - 2}$ |
| $\gamma_{\pi\tau}^o = 0 + 0$ |
| [a] $\gamma_\pi^o = \left[\frac{\partial \gamma^o}{\partial \pi}\right]_\tau$, $\gamma_{\pi\pi}^o = \left[\frac{\partial^2 \gamma^o}{\partial \pi^2}\right]_\tau$, $\gamma_\tau^o = \left[\frac{\partial \gamma^o}{\partial \tau}\right]_\pi$, $\gamma_{\tau\tau}^o = \left[\frac{\partial^2 \gamma^o}{\partial \tau^2}\right]_\pi$, $\gamma_{\pi\tau}^o = \left[\frac{\partial^2 \gamma^o}{\partial \pi \partial \tau}\right]$ |

**The Residual Part $\gamma^r$ of the Dimensionless Gibbs free Energy and its Derivatives[a] According to Equation (62)**

| | |
|---|---|
| $\gamma^r = \sum_{i=1}^{6} n_i \pi^{I_i} \tau^{J_i}$ | |
| $\gamma_\pi^r = \sum_{i=1}^{6} n_i I_i \pi^{I_i - 1} \tau^{J_i}$ | $\gamma_{\pi\pi}^r = \sum_{i=1}^{6} n_i I_i (I_i - 1) \pi^{I_i - 2} \tau^{J_i}$ |
| $\gamma_\tau^r = \sum_{i=1}^{6} n_i \pi^{I_i} J_i \tau^{J_i - 1}$ | $\gamma_{\tau\tau}^r = \sum_{i=1}^{6} n_i \pi^{I_i} J_i \left(J_i - 1\right) \tau^{J_i - 2}$ |
| $\gamma_{\pi\tau}^r = \sum_{i=1}^{6} n_i I_i \pi^{I_i - 1} J_i \tau^{J_i - 1}$ | |
| [a] $\gamma_\pi^r = \left[\frac{\partial \gamma^r}{\partial \pi}\right]_\tau$, $\gamma_{\pi\pi}^r = \left[\frac{\partial^2 \gamma^r}{\partial \pi^2}\right]_\tau$, $\gamma_\tau^r = \left[\frac{\partial \gamma^r}{\partial \tau}\right]_\pi$, $\gamma_{\tau\tau}^r = \left[\frac{\partial^2 \gamma^r}{\partial \tau^2}\right]_\pi$, $\gamma_{\pi\tau}^r = \left[\frac{\partial^2 \gamma^r}{\partial \pi \partial \tau}\right]$ | |

## 6 CONSISTENCY AT REGION BOUNDARIES

For any calculation of thermodynamic properties of water and steam across the region boundaries, the equations of IAPWS-IF97 have to be sufficiently consistent along the corresponding boundary. For the properties considered in this respect, this section presents the achieved consistencies in comparison to the permitted inconsistencies according to Prague values (*see* 13 of Annex C).

### 6.1 Consistency at Boundaries between Single-Phase Regions

For the boundaries between single-phase regions, the consistency investigations were performed for the following basic equations and region boundaries; *see* Figure at clause 5:

a) Equations (7) and (34) along the 623.15 *K* isotherm for pressures from 16.53 MPa ($p_s$ from Eq. (52) for 623.15 K) to corresponding to the boundary between regions 1 and 3;

b) Equations (16) and (34) with respect to the boundary between regions 2 and 3 defined by the B23-equation, Eq. (5), for temperatures between 623.15 K and 863.15 K;

c) Equations (16) and (60) with respect to the 1073.15 K isotherm for $p \leq 50$ MPa corresponding to the boundary between regions 2 and 5.

The outcomes of the consistency investigations for these three region boundaries are abridged in the following Table. Along with the allowable inconsistencies conforming to the Prague values (*see* 13 of Annex C), the actual inconsistencies characterized by their maximum and root-mean-square values, $|\Delta x|_{max}$ and $\Delta x_{RMS}$, along the three boundaries are given for $x = v, h, c_p, s, g$ and $w$. It appears that the inconsistencies among the basic equations along the conforming region boundaries are exceptionally small.

**Inconsistencies Between Basic Equations for Single-Phase Regions at the Joint Region Boundary**

| *Inconsistency* | *Prague Value* | *Regions 1/3 Eqs. (7)/(34)* | | *Regions 2/3 Eqs. (16)/(34)* | | *Regions 2/5 Eqs. (16)/(60)* | |
|---|---|---|---|---|---|---|---|
| | | $\Delta x\|_{max}$ | $\Delta x_{RMS}$ [a] | $\Delta x\|_{max}$ | $\Delta x_{RMS}$ [a] | $\Delta x\|_{max}$ | $\Delta x_{RMS}$ [a] |
| $\|\Delta v\|$/% | 0.05 | 0.004 | 0.002 | 0.018 | 0.007 | 0.012 | 0.007 |
| $\|\Delta h\|/(kJ\ kg^{-1})$ | 0.2 | 0.031 | 0.014 | 0.134 | 0.073 | 0.096 | 0.070 |
| $\|\Delta c_p\|$/% | 1 | 0.195 | 0.058 | 0.353 | 0.169 | 0.074 | 0.049 |
| $\|\Delta s\|/(J\ kg^{-1} K^{-1})$ | 0.2 | 0.042 | 0.022 | 0.177 | 0.094 | 0.142 | 0.084 |
| $\|\Delta g\|/(kJ\ kg^{-1})$ | 0.2 | 0.005 | 0.005 | 0.005 | 0.003 | 0.087 | 0.072 |
| $\|\Delta w\|$/% | 1[b] | 0.299 | 0.087 | 0.403 | 0.073 | 0.046 | 0.028 |

[a] The $\Delta x_{RMS}$ values (*see* Nomenclature) were calculated from about 10 000 points evenly distributed along the corresponding boundary.

[b] The permitted inconsistency value for *w* is not included in the Prague values (*see* 13 of Annex C).

### 6.2 Consistency at the Saturation Line

The consistency investigations along the vapor-liquid saturation line were performed for the properties $p_s$, $T_s$ and $g$. The calculations concern the following basic equations and ranges of the saturation line, see Figure at clause 5; the way of calculating the inconsistencies $\Delta p_s$, $\Delta T_s$, and $\Delta g$ is also given:

- Equations (7), (16) and (52) on the saturation line for temperatures from $T_t$ = 273.15 *K* to 623.15 *K*.

$$\Delta p_s = p_{s,Eq.(7),Eq.(16)} - p_{s,Eq.(52)} \quad ...(63a)$$

$$\Delta T_s = T_{s,\ Eq.(7),\ Eq.(16)} - T_{s,\ Eq.(53)} \quad ...(63b)$$

$$\Delta g = g_{Eq.(7)} - g_{Eq.(16)} \quad ...(63c)$$

The calculation of $p_s$ and of $T_s$ from Eqs. (7) and (16) is made via the Maxwell criterion (phase-equilibrium condition) for given values of $T$ or $p$. The $g$ values are determined for given $T$ values and corresponding $p_s$ values from Eq. (52).

Equations (34) and (52) on the saturation line for temperatures from 623.15 K to $T_c$ = 647.096 K.

$$\Delta p_s = p_{s,Eq.(34)} - p_{s,Eq.(52)} \quad ...(64a)$$

$$\Delta T_s = T_{s,Eq.(34)} - T_{s,Eq.(53)} \quad ...(64b)$$

$$\Delta g = g'_{Eq.(34),Eq.(52)} - g''_{Eq.(34),Eq.(52)} \quad ...(64c)$$

The calculation of $p_s$ and $T_s$ from Eq. (34) is made via the Maxwell criterion for given temperatures or pressures, respectively. The inconsistency $\Delta g$ corresponds to the difference $g'(\rho', T) - g''(\rho'', T)$ which is calculated from Eq. (34) after $\rho'$ and $\rho''$ are determined from Eq. (34) by iteration for given $T$ values and corresponding $p_s$ values from Eq. (52).

Equations (7), (16) and (34) on the saturation line at 623.15 K. This is the only point on the saturation line where the validity ranges of the fundamental equations of regions 1 to 3 meet each other.

$$\Delta p_s = p_{s,\ Eq.(7),\ Eq.(16)} - p_{s,\ Eq.(34)} \quad ...(65a)$$

$$\Delta T_s = T_{s,\ Eq.(7),\ Eq.(16)} - T_{s,\ Eq.(34)} \quad ...(65b)$$

$$\Delta g = g_{Eq.(7),\ Eq.(16)} - g_{Eq.(34)} \quad ...(65c)$$

All three properties $p_s$ and $T_s$ and $g$ and and are calculated via the Maxwell criterion from the corresponding equations.

The outcomes of these consistency investigations along the saturation line are abridged in following Table. Along with the allowable inconsistencies conforming to the Prague values (*see* 13 of Annex C), the actual inconsistencies characterized by their maximum and root-mean-square values, $|\Delta x|_{max}$ and $|\Delta x|_{RMS}$, for the two sections of the saturation line are given for $x = p_s$, $T_s$ and $g$. It appears that the inconsistencies among the basic equations for the conforming single-phase region and the saturation-pressure equation are exceptionally small. This statement also holds for the fundamental equations, Eqs. (7), (16), and (34), among one another and not only in relation to the saturation-pressure equation, Eq. (52), which can be seen in the last column of the following table:

**Inconsistencies Between the Basic Equations Valid at the Saturation Line**

| *Inconsistency* $\Delta x$ | *Prague Value* | $T_t \le T \le 623.15\ K$ *Eqs. (7), (16)/(52)* | | $623.15\ K \le T \le T_c$ *Eqs. (34)/(52)* | | $T = 623.15\ K$ *Eqs. (7), (16)/(34)* |
|---|---|---|---|---|---|---|
| | | $\lvert\Delta x\rvert_{max}$ | $\Delta x_{RMS}$ [a] | $\lvert\Delta x\rvert_{max}$ | $\Delta x_{RMS}$ [a] | |
| $\lvert\Delta p_s\rvert$/% | 0.05 | 0.0069 | 0.0033 | 0.0026 | 0.0015 | 0.0041 |
| $\lvert\Delta T_s\rvert$/% | 0.02 | 0.0006 | 0.0003 | 0.0003 | 0.0002 | 0.0006 |
| $\lvert\Delta g\rvert/(kJ\ kg^{-1})$ | 0.2 | 0.012 | 0.006 | 0.002 | 0.001 | 0.005 |

[a] The $\Delta x_{RMS}$ [a] values (*see* Nomenclature) were calculated from about 3000 points evenly distributed along the two sections of the saturation line.

## 7 ESTIMATES OF UNCERTAINTIES

Estimates have been made of the uncertainty of the specific volume, specific isobaric heat capacity, speed of sound, and saturation pressure when calculated from the corresponding equations of IAPWS-IF97. These estimates were derived from the uncertainties of IAPWS-95 (*see* 3 of Annex C), from which the input values for fitting the IAPWS-IF97 equations were calculated, and in addition by taking into account the deviations between the corresponding values calculated from IAPWS-IF97 and IAPWS-95. Since there is no reasonable basis for estimating the uncertainty of specific enthalpy (because specific enthalpy is dependent on the selection of the zero point, only enthalpy differences of different size are of interest), no uncertainty is given for this property. However, the uncertainty of isobaric enthalpy differences is smaller than the uncertainty in the isobaric heat capacity.

For the single-phase region, tolerances are indicated in following Figures which give the estimated uncertainties in various areas. As used here "tolerance" means the range of possible values as judged by IAPWS, and no statistical significance can be attached to it.

With regard to the uncertainty for the speed of sound and the specific isobaric heat capacity, see the following Figures, it should be noted that the uncertainties for these properties increase drastically when approaching the critical point. The statement "no definitive uncertainty estimates possible" for temperatures above 1 273K is based on the fact that this range is beyond the range of validity of IAPWS-95 and the corresponding input values for IAPWS-IF97 were extrapolated from IAPWS-95. From various tests of IAPWS-95 (*see* 3 of Annex C) it is expected that these extrapolations yield reasonable values.

For the saturation pressure, the estimate of uncertainty is shown in the following Figure. Estimated uncertainties in enthalpy, in enthalpy differences in the single-phase region, and in the enthalpy of vaporization are given in IAPWS Advisory Note No. 1 (*see* 14 Annex C).

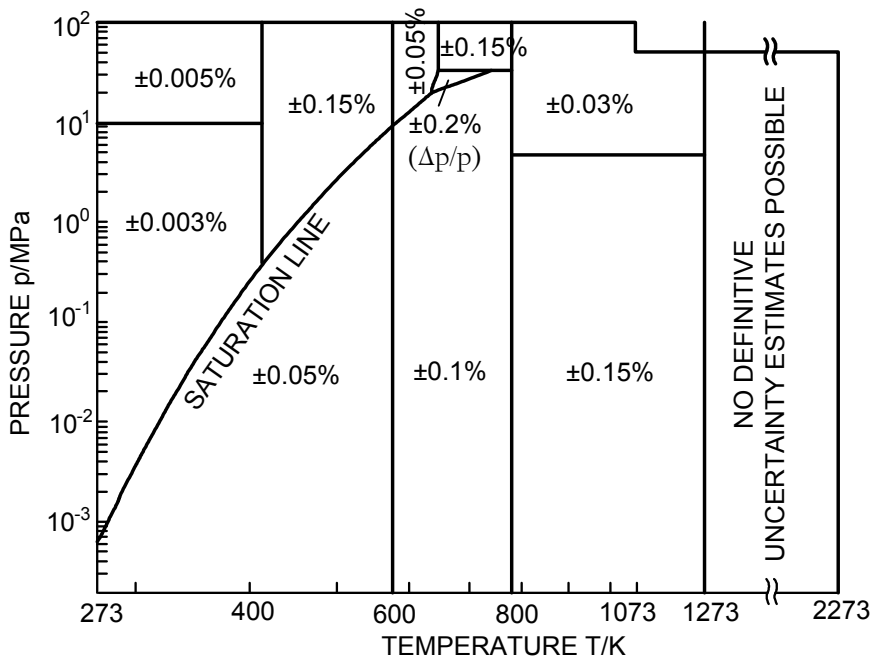



Fig. 7-1 Uncertainties in Specific Volume, ΔV/V, Estimated for the Corresponding Equations of IAPWS-IF 97. In Enlarged Critical Region (Triangle), the Uncertainty is Given as Percentage Uncertainty in Pressure, Δ p/p. This Region is Bordered by the Two Isochores 0.0019 $m^3$ kg-1 and 0.0069$m^3$ kg-1 and by the 30 MPA Isobar. The Positions of the Lines Separating the Uncertainty Regions are Approximate

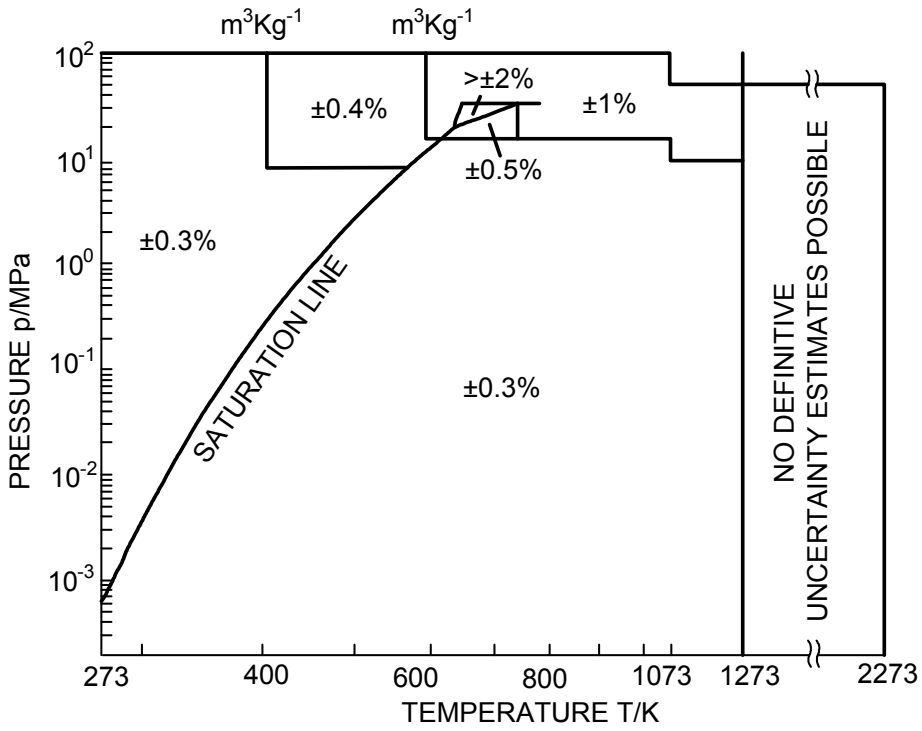



Fig. 7-2 Uncertainties in Specific Isobaric Heat Capacity, ΔCp/Cp, Estimated for the Corresponding Equations of IAPWS-IF 97. For the Definition of the Triangle Around the Critical Point, See Fig. 7.1 The Positions of the Lines Separating the Uncertainty Regions are Approximate

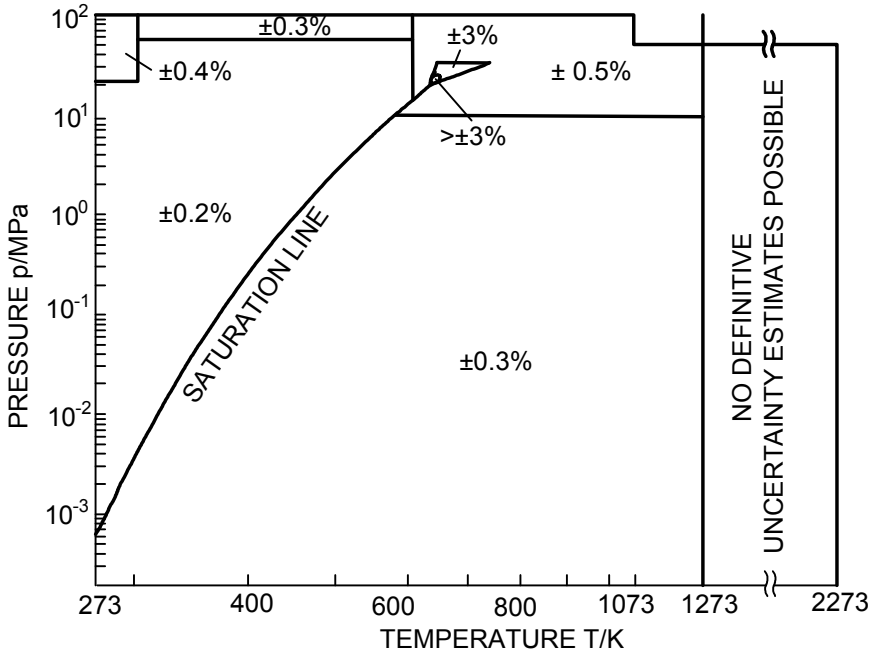



Fig. 7-3 Uncertainties in Speed of Sound, AW/W, Estimated for the Corresponding Equations of IAPWS-IF 97. For the Definition of the Triangle Around the Critical Point, See Fig.7.1 The Positions of the Lines Separating the Uncertainty Regions are Approximate

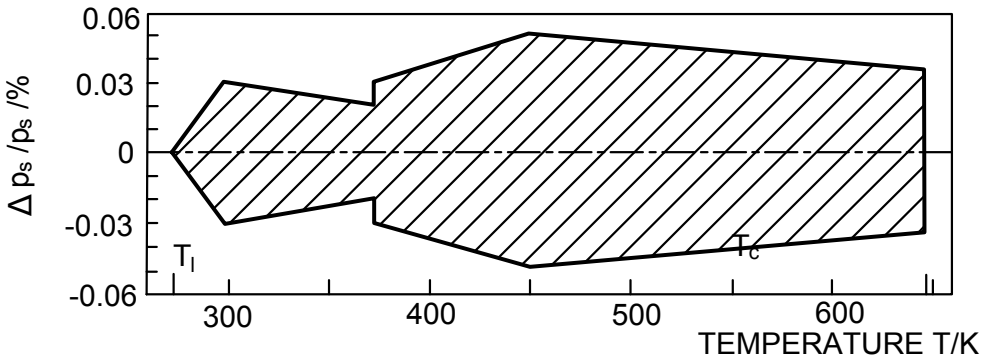



Fig. 7-4 Uncertainties In Saturation Pressure, Δps/ps, Estimated for the Saturation-Pressure Equation, Eq.(30)

## 8 TRANSPORT PROPERTIES AND FORMULATION

Thermal conductivity and viscosity are two of the key transport properties needed to solve many problems related to heat transfer and fluid mechanics. The International Association for the Properties of Water and Steam (IAPWS) has examined the experimental data for these properties and developed standard correlating equations to describe their behavior at different state conditions.

### 8.1 Viscosity

Tables 8 (*see* Annex A) and Figure 2 (*see* Annex B) give results for the viscosity (also called the *dynamic* viscosity to distinguish it from the *kinematic* viscosity mentioned below) of water and steam according to the formulation appropriate to industrial calculations. Figures 3 (*see* Annex B) show the kinematic viscosity, a convenient quantity in many fluid-flow calculations, which is the dynamic viscosity multiplied by the specific volume.

The calculations of the viscosity are based on the IAPWS release (*see* 15 of Annex C). The equations used for the calculations in this standard are given in **8.4.1**, along with information on the uncertainty of the formulation. The viscosity surface for water is represented by a function of temperature and density that includes contributions to the fluid viscosity from the dilute-gas limit (a function of temperature only), from interactions at higher densities, and from critical-region phenomena. Because the contribution from critical phenomena is significant only in a very narrow region around the critical point of water, as indicated in the IAPWS release, and it is not incorporated in the tabular form in this standard.

### 8.2 Thermal Conductivity

Tables 9 (*see* Annex A) and Figures 4 (*see* Annex B) give results for the thermal conductivity of water and steam according to the formulation appropriate to industrial calculations. The calculations of the thermal conductivity are based on the IAPWS release (*see* 16 of Annex C). The equations used for the calculations in this standard are given in **8.4.2**, along with information on the uncertainty of the formulation.

The IAPWS formulation represents the thermal conductivity surface for water as a function of temperature and density, including contributions from the dilute-gas limit (a function of temperature only), from interactions at higher densities, and from the enhancement of the thermal conductivity that is manifested in a wide region around the critical point. For industrial use, the IAPWS-IF97 thermodynamic formulation is used to calculate the thermodynamic derivatives required for the critical enhancement term.

### 8.3 Prandtl Number

The Prandtl number is a dimensionless group that arises in heat-transfer problems. It is the product of the isobaric heat capacity and the dynamic viscosity divided by the thermal conductivity. The reciprocal of the Prandtl number is shown in Figure 5 (*see* Annex B). Some small discontinuities (due to discontinuities in the isobaric heat capacity, *see* para 5) at the region boundaries have been smoothed in constructing these figures.

### 8.4 Structure of the Formulation

This section represents the equations used to generate the viscosity and thermal conductivity. The content presented here is principally consolidated form of the material in the IAPWS release documents (*see* 15, 16 of Annex C).

Only the actual equations, their scope of legitimacy and their uncertainty are archived here. The reference mentioned above should be consulted for other details.

**8.4.1** *Viscosity Formulation*

This section contains equation used to generate the viscosity, necessary constants, range of validity of the equation and the estimates of the uncertainty of the equation of pure water substance over an extensive range of fluid states.

The reference constant used in this formulation is identical to that of the critical temperature, pressure and density of the water from the corresponding IAPWS release (*see* 8 of Clause C).

Reference temperature peruses,

$$T^* = 647.096 \text{ K} \quad \ldots (66)$$

Reference density peruses,

$$\rho^* = 322.0 \text{ kg.m}^{-3} \quad \ldots (67)$$

Reference pressure peruses,

$$p^* = 22.046 \text{ MPa} \quad \ldots (68)$$

Reference viscosity peruses,

$$\mu^* = 1 \times 10^{-6}) \text{ Pa.s} \quad \ldots (69)$$

The viscosity is represented by the following equation,

$$\bar{\mu} = \bar{\mu}_0\left(\bar{T}\right) \times \bar{\mu}_1\left(\bar{T}, \bar{\rho}\right) \times \bar{\mu}_2\left(\bar{T}, \bar{\rho}\right) \quad \ldots (70)$$

where $\bar{\mu} = \mu / \mu^* \bar{T} = T / T^*$ and $\bar{\rho} = \rho / \rho^*$.

The first factor $\bar{\mu}_0$ of the product represents the viscosity in the dilute-gas limit and peruses,

$$\bar{\mu}_0\left(\bar{T}\right) = \frac{100\sqrt{\bar{T}}}{\sum_{i=0}^{3} \frac{H_i}{\bar{T}^i}} \quad \ldots (71)$$

with the coefficients of $H_i$ given in following table:

**Coefficients $H_i$ for $\bar{\mu}_0(\bar{T})$, Eq. (71)**

| i | $H_i$ |
|---|---|
| 0 | 1.67752 |
| 1 | 2.20462 |
| 2 | 0.6366564 |
| 3 | – 0.241605 |

The second multiplicative factor $\bar{\mu}_1$ represents the contribution to viscosity due to finite density:

$$\bar{\mu}_1\left(\bar{T}, \bar{\rho}\right) = \exp\left[\bar{\rho} \sum_{i=0}^{5} \left(\frac{1}{\bar{T}} - 1\right)^i \sum_{j=0}^{6} H_{ij} \left(\bar{\rho} - 1\right)^j\right] \quad \ldots (72)$$

with the coefficients $H_{ij}$ of given in following table. The third factor $\bar{\mu}_2$ represents the critical enhancement of the viscosity.

**Coefficients $H_{ij}$ for $\bar{\mu}_1(\bar{T}, \bar{\rho})$, Eq. (72)**

| i | $j$ | $H_i$ |
|---|---|---|
| 0 | 0 | $5.20094 \times 10^{-1}$ |
| 1 | 0 | $8.50895 \times 10^{-2}$ |
| 2 | 0 | $-1.08374$ |
| 3 | 0 | $-2.89555 \times 10^{-1}$ |
| 0 | 1 | $2.22531 \times 10^{-1}$ |
| 1 | 1 | $9.99115 \times 10^{-1}$ |
| 2 | 1 | 1.88797 |
| 3 | 1 | 1.26613 |
| 5 | 1 | $1.20573 \times 10^{-1}$ |
| 0 | 2 | $-2.81378 \times 10^{-1}$ |
| 1 | 2 | $-9.06851 \times 10^{-1}$ |
| 2 | 2 | $-7.72479 \times 10^{-1}$ |
| 3 | 2 | $-4.89837 \times 10^{-1}$ |
| 4 | 2 | $-2.57040 \times 10^{-1}$ |
| 0 | 3 | $1.61913 \times 10^{-1}$ |
| 1 | 3 | $2.57399 \times 10^{-1}$ |
| 0 | 4 | $-3.25372 \times 10^{-2}$ |
| 3 | 4 | $6.98452 \times 10^{-2}$ |
| 4 | 5 | $8.72102 \times 10^{-3}$ |
| 3 | 6 | $-4.35673 \times 10^{-3}$ |
| 5 | 6 | $-5.93264 \times 10^{-4}$ |

NOTE — Coefficients $H_{ij}$ omitted from the above Table are identically equal to zero.

The critical enhancement is only significant in a very small region in density and temperature around the critical point. Although exactly at the critical point the viscosity is infinite, the enhancement term contributes an amount greater than 2 percent of the full viscosity only within the following boundaries:

$$645.91 \text{ K} < T < 650.77 \text{ K},$$

$$245.8 \text{ kg.m}^{-3} < \rho < 405.3 \text{ kg.m}^{-3} \quad \ldots (73)$$

Thus, the critical enhancement is significant only within the boundaries specified by Eq. (73); outside this region, the enhancement is always less than the uncertainty in the formulation.

The function $\bar{\mu}_2$ is defined over the entire range of states by:

$$\bar{\mu}_2 = \exp\left(x_\mu Y\right) \quad \ldots (74)$$

where $x_\mu$ is the critical exponent for viscosity and the function $Y$ is defined for two ranges of correlation length ξ For $0 \le \xi \le 0.3817016416$ nm.

$$Y = \frac{1}{5} q_C \xi \left(q_D \xi\right)^5 \left(1 - q_C \xi + \left(q_C \xi\right)^2 - \frac{765}{504}\left(q_D \xi\right)^2\right) \quad \ldots (75)$$

While for $\xi > 0.3817016416$ nm

$$Y = \begin{array}{l} \frac{1}{12}\sin(3\psi_D) - \frac{1}{4q_C\xi}\sin(2\psi_D) + \frac{1}{(q_C\xi)^2}\left[1-\frac{5}{4}(q_C\xi)^2\right]\sin(\psi_D) \\ -\frac{1}{(q_C\xi)^3}\left\{\left[1-\frac{3}{2}(q_C\xi)^2\right]\psi_D - \left|(q_C\xi)^2-1\right|^{\frac{3}{2}} L(w)\right\} \end{array} \quad ...(76)$$

With

$$\psi_D = arccos\left[\left(1+q_D{}^2\xi^2\right)^{\frac{-1}{2}}\right] \quad ...(77)$$

And with the function $L$(w) given by

$$L(w) = \left\{\begin{array}{ll} ln\frac{1+w}{1-w}, & for\, q_C\xi > 1 \\ 2\,arctan|w|, & for\, q_C\xi \le 1 \end{array}\right\} \quad ...(78)$$

The variable ($w$) is defined by

$$w = \left|\frac{q_C\xi - 1}{q_C\xi + 1}\right|^{1/2} \tan\left(\frac{\psi_D}{2}\right) \quad ...(79)$$

The critical enhancement of viscosity given by Equations (74)–(79) is a function of the correlation length ξ:

$$\xi = \xi_0\left(\frac{\Delta\bar{\chi}}{\Gamma_0}\right)^{\nu/\gamma} \quad ...(80)$$

In terms of $\Delta\bar{\chi}$ ($\ge 0$) which is defined by

$$\Delta\bar{\chi} = \bar{\rho}\left[\varsigma\left(\bar{T},\bar{\rho}\right) - \varsigma\left(\overline{T_R},\bar{\rho}\right)\frac{\overline{T_R}}{\bar{T}}\right] \quad ...(81)$$

$$\varsigma = \left(\frac{\partial\bar{\rho}}{\partial\bar{p}}\right)_{\bar{T}} \quad ...(82)$$

When $\Delta\bar{\chi}$ calculated by eq. (81) is less than zero, it must be set to zero for calculations to proceed.

The constants needed to compute the critical enhancement, $\bar{\mu}_2$, are provided in following table:

**Critical Region Constants**

| *Constant* | *Value* |
|---|---|
| $x_\mu$ | 0.068 |
| $\bar{q}_C^{-1}$ | 1.9 nm |
| $\bar{q}_D^{-1}$ | 1.1 nm |
| $\nu$ | 0.630 |
| γ | 1.239 |
| $\xi_0$ | 0.13 nm |
| $\Gamma_0$ | 0.06 |
| $\bar{T}_R$ | 1.5 |

1) *Range of Validity*

For industrial use, Eq. (70) may be used for the viscosity defined by the following temperature and pressure range:

273.15 K ≤ $T$ ≤ 1 073.15 K  $p$ ≤ 100 MPa

1 073.15 K ≤ $T$ ≤ 1 173.15 K  $p$ ≤ 50 MPa

Above mentioned pressure limit is the limit of the IAPWS-IF97 thermodynamic property formulation. The viscosity surface itself determined to cover data at elevated pressure and may be used in an extensive range [as specified in IAPWS release (*see* 15 and 21 of Annex C)] if an equation of state legitimate for that range is accessible.

2) *Estimates of Uncertainties*

The uncertainty (combined extended uncertainty with scope factor of two) of the viscosity of water has been derived by IAPWS as described in the release (*see* 15 of Annex C). All in all, for the liquid phase below 573.15 K these uncertainties are about 1 percent, 2 percent for the vapour at low and moderate temperatures and liquid above 573.15 K, and 3 percent for temperatures above 773.15 K (for pressures below 45 MPa) or above 613.15 K (for pressures above 45 MPa) and for high-pressure liquids that exist below 273.15 K. The IAPWS release (*see* 15 of Annex C) should be consulted for more complete information. The estimated uncertainty is shown in following Figure.

**8.4.2** *Thermal Conductivity Formulation*

This section contains equation used to generate the thermal conductivity, necessary constants, range of validity of the equation and the estimates of the uncertainty of the equation.

The reference constant used in this formulation is identical to that of the critical temperature, pressure and density of the water from the corresponding IAPWS release (*see* 8 of Annex C).

Reference temperature peruses,

$$\boldsymbol{T^* = 647.096\ K} \quad \ldots (83)$$

Reference density peruses,

$$\boldsymbol{\rho^* = 322.0\ kg.m^{-3}} \quad \ldots (84)$$

Reference pressure peruses,

$$\boldsymbol{p^* = 22.046\ MPa} \quad \ldots (85)$$

Reference viscosity peruses,

$$\boldsymbol{\mu^* = 1 \times 10^{-6}\ Pa.s} \quad \ldots (86)$$

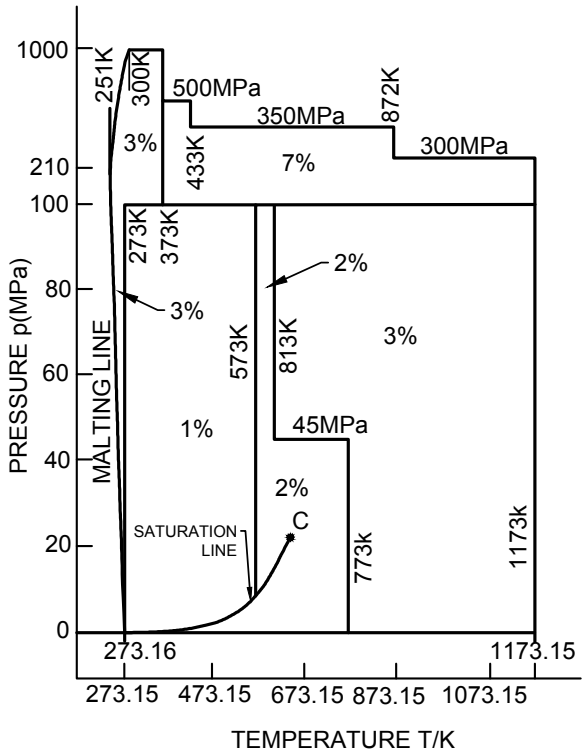



FIG. 8-1 ESTIMATED UNCERTAINTY OF THE CORRELATING EQUATION

Reference thermal conductivity peruses,

$$\lambda = 1 \times 10^{-3}\ \mathrm{W\ m^{-1}\ K^{-1}} \qquad ...(87)$$

Specific gas constant

$$R = 0.46151805\ \mathrm{kJ\ kg^{-1}\ K^{-1}} \qquad \ldots (88)$$

The thermal conductivity is represented by following equation,

$$\bar{\lambda} = \bar{\lambda}_0\left(\bar{T}\right) \times \bar{\lambda}_1\left(\bar{T},\bar{\rho}\right) + \bar{\lambda}_2\left(\bar{T},\bar{\rho}\right) \qquad \ldots (89)$$

where $\bar{\lambda} = \lambda / \lambda^*, \bar{T} = T / T^*$ and $\bar{\rho} = \rho / \rho^*$.

The first factor $\bar{\lambda}_0$ of the product in Eq. (89) represents the thermal conductivity in the dilute-gas limit and peruses,

$$\bar{\lambda}_0\left(\bar{T}\right) = \frac{\sqrt{\bar{T}}}{\sum_{k=0}^{4} \frac{L_k}{\bar{T}^k}} \qquad \ldots (90)$$

with the coefficients of $L_k$ given in following table:

**Coefficients $L_k$ in Eq. (90) for $\bar{\lambda}_0(\bar{T})$**

| $k$ | $L_k$ |
|---|---|
| 0 | $2.443\ 221 \times 10^{-3}$ |
| 1 | $1.323\ 095 \times 10^{-2}$ |
| 2 | $6.770\ 357 \times 10^{-3}$ |
| 3 | $-3.454\ 586 \times 10^{-3}$ |
| 4 | $4.096\ 266 \times 10^{-4}$ |

The second factor $\bar{\lambda}_1$ of the product in Eq. (89) represents the contribution to thermal conductivity due to finite density:

$$\lambda_1\left(\bar{T},\bar{\rho}\right) = \exp\left[\bar{\rho}\sum_{i=0}^{4}\left(\frac{1}{\bar{T}}-1\right)^i \sum_{j=0}^{5} L_{ij}\left(\bar{\rho}-1\right)^j\right] \qquad \ldots (91)$$

with the coefficients of $L_{ij}$ given in following table:

**Coefficients $L_{ij}$ in Eq. (91) for $\lambda_1(\bar{T},\bar{\rho})$**

| *j* | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| *i* | | | | | | |
| 0 | 1.603 973 57 | –0.646 013 523 | 0.111 443 906 | 0.102 997 357 | –0.0504123634 | 0.00609859258 |
| 1 | 2.337 718 42 | –2.788 437 78 | 1.536 161 67 | –0.463 045 512 | 0.0832827019 | –0.00719201245 |
| 2 | 2.196 505 29 | –4.545 807 85 | 3.557 772 44 | –1.409 449 78 | 0.275 418 278 | –0.020 593 8816 |
| 3 | –1.210 513 78 | 1.608 129 89 | –0.621 178 141 | 0.071637 3324 | 0 | 0 |
| 4 | –2.720 337 0 | 4.575 863 31 | –3.183 692 45 | 1.116 834 8 | –0.192 683 05 | 0.012 913 842 |

The additive contribution $\bar{\lambda}_2$ in Eq. (89) represents the critical enhancement of the thermal conductivity. This additive contribution is defined over the entire range of states by,

$$\bar{\lambda}_2(\bar{T},\bar{\rho}) = \Lambda \frac{\bar{\rho}\bar{c}_p\bar{T}}{\bar{\mu}} Z(y) \qquad \ldots (92)$$

where $\Lambda$ is a numerical constant, $\bar{c}_p = \frac{c_p}{R}, \bar{\mu} = \mu / \mu^*$. The function $Z(y)$ is defined by,

$$Z(y) = \frac{2}{\pi y}\left\{\left[\left(1-\kappa^{-1}\right)\arctan(y) + \kappa^{-1} y\right] - \left[1-\exp\left(\frac{-1}{y^{-1}+y^2/3\bar{\rho}^2}\right)\right]\right\} \qquad ...(93)$$

where $\kappa = c_p/c_v$ and

$$y = \bar{q}_D \xi(\bar{T},\bar{\rho}) \qquad ...(94)$$

In Eq. (94), $\bar{q}_D$ is a reference wave number and $\xi$ a correlation length, so that $y$ is a dimensionless variable. To avoid numerical truncation issues in Eq. (93) for small values of $y$, the function $Z(y)$ is subject to the condition

$$Z(y) = 0 \text{ for } y < 1.2 \times 10^{-7} \qquad ...(95)$$

The correlation length $\xi$ in Eq. (94) is calculated from:

$$\xi = \xi_0 \left(\frac{\Delta\bar{\chi}}{\Gamma_0}\right)^{\nu/\gamma} \qquad ...(96)$$

In terms of $\Delta\bar{\chi}$ ($\geq 0$) defined by,

$$\Delta\bar{\chi}(\bar{T},\bar{\rho}) = \rho\left[\zeta(\bar{T},\bar{\rho}) - \zeta(\bar{T}_R,\bar{\rho})\frac{\bar{T}_R}{\bar{T}}\right] \qquad ...(97)$$

with

$$\zeta = \left(\frac{\partial\bar{\rho}}{\partial\bar{p}}\right)_{\bar{T}} \qquad ...(98)$$

where $\xi_0$, $\Gamma_0$, $\nu$, and $\gamma$ are constants.

When $\Delta\bar{\chi}$ calculated from Eq. 97 is less than zero, it must be set to zero for calculations to proceed[1].

The constants needed to compute the critical enhancement, $\bar{\lambda}_2$ are provided in following table:

**Critical Region Constants**

| *Constant* | *Value* |
|---|---|
| $\Lambda$ | 177.8514 |
| $\bar{q}_D^{-1}$ | 0.40 nm |
| $\nu$ | 0.630 |
| $\gamma$ | 1.239 |
| $\xi_0$ | 0.13 nm |
| $\Gamma_0$ | 0.06 |
| $\bar{T}_R$ | 1.5 |

[1]Due to the numerical implementation of the equation of state, the calculated singularity in the first derivative in Eq. 97 may not occur exactly at $T_c = T^*$ and $\rho_c = \rho^*$ as it should. Therefore, calculated values of $\bar{\lambda}_2$ may behave unphysically at points extremely close to the critical point (approximately within 0.01 kg m$^{-3}$ of $\rho_c$ on the critical isotherm). The formulation should be used with caution in this very small region.

For industrial applications where greater computing speed is needed, the dimensionless isobaric specific heat capacity, $\bar{c}_p$, in Eq. (92), the heat-capacity ratio, $\kappa$, in Eq. (93), and the dimensionless isothermal compressibility, $\zeta$, in Eq. (97) should be calculated from the IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam [*see* 12, Annex C], while the dimensionless viscosity, $\bar{\mu}$, in Eq. (92) should be calculated from the recommended viscosity correlation for industrial application as described in the IAPWS Formulation 2008 for the Viscosity of Ordinary Water Substance [*see* 15, Annex C], with one exception:

The function $\zeta(\bar{T}_R,\bar{\rho})$ in Eq. (97) is to be calculated from:

$$\zeta(\bar{T}_R,\bar{\rho}) = \frac{1}{\sum_{i=0}^{5} A_{ij}\bar{\rho}^i} \qquad ...(99)$$

with coefficients given in following table:

**Coefficients $A_{ij}$ in Eq. (99) for $\zeta\,(\bar{T}_R, \bar{\rho})$**

| | $j = 0$ | $j = 1$ | $j = 2$ | $j = 4$ | $j = 5$ |
|---|---|---|---|---|---|
| $i = 0$ | 6.53786807199516 | 6.52717759281799 | 5.35500529896124 | 1.55225959906681 | 1.11999926419994 |
| $i = 1$ | −5.61149954923348 | −6.30816983387575 | −3.96415689925446 | 0.464621290821181 | 0.595748562571649 |
| $i = 2$ | 3.39624167361325 | 8.08379285492595 | 8.91990208918795 | 8.93237374861479 | 9.88952565078920 |
| $i = 3$ | −2.27492629730878 | −9.82240510197603 | −12.0338729505790 | −11.0321960061126 | −10.3255051147040 |
| $i = 4$ | 10.2631854662709 | 12.1358413791395 | 9.19494865194302 | 6.16780999933360 | 4.66861294457414 |
| $i = 5$ | 1.97815050331519 | −5.54349664571295 | −2.16866274479712 | −0.965458722086812 | −0.503243546373828 |

The subscript $j$ denotes ranges defined as:

$$\begin{aligned} j = 0&: \quad \bar{\rho} \le 0.310559006 \\ j = 1&: \quad 0.310559006 < \bar{\rho} \le 0.776397516 \\ j = 2&: \quad 0.776397516 < \bar{\rho} \le 1.242236025 \qquad ...(100) \\ j = 3&: \quad 1.242236025 < \bar{\rho} \le 1.863354037 \\ j = 4&: \quad 1.863354037 < \bar{\rho} \end{aligned}$$

1) *Range of Validity*

IAPWS endorses the validity of Eq. 89 for the thermal conductivity for industrial use in the following range of pressures and temperatures $T$:

$$273.15\ \text{K} \le T \le 1\,073.15\ \text{K} \qquad p \le 100\ \text{MPa}$$

$$1\,073.15\ \text{K} \le T \le 1\,173.15\ \text{K} \qquad p \le 50\ \text{MPa}$$

2) *Estimates of Uncertainties*

The uncertainty (combined extended uncertainty with scope factor of two) of the thermal conductivity of water has been derived by IAPWS as presented in the release (*see* 16 of Annex C). All in all, these uncertainties are about 1.5 percent for the liquid phase below 523.15 K and 50 MPa, 2 percent for the vapour at low and moderate temperatures and for the liquid above 523.15 K and/or above 50 MPa, 4 percent for temperatures between 699.15 K and 824.15 K, and 6 percent for temperatures above 824.15 K. The IAPWS release (*see* 16 of Annex C) should be consulted for more complete information. The estimated uncertainty shown in following Figure.

## 9 OTHER PROPERTIES AND FORMULATION

### 9.1 Surface Tension

The one property included in these tables that is not covered in the earlier clauses is the vapor liquid surface tension. The surface tension is defined along the vapor-liquid saturation curve; therefore, only the temperature is necessary to specify the state. The surface tension given in table T-11 (*see* Annex A) is computed from IAPWS release (*see* 20 of Annex C).

### 9.2 Structure of the Formulation

This section represents the equations used to generate the surface tension. The content presented here is principally consolidated form of the material in the IAPWS release documents (*see* 20 of Annex C). Only the actual equations and their scope of legitimacy are archived here. The reference mentioned above should be consulted for other details.

**9.2.1** *Surface Tension Formulation*

The following recommended interpolating equation gives values of surface tension within stated uncertainty:

$$\sigma = B\tau^{\mu}\,(1 + b\tau) \qquad ...(101)$$

Where $\sigma$ = *Surface tension*

$$\tau = 1 - T/T_c$$

$T$ = *absolute temperature*

$T_c$ = 647.096 K

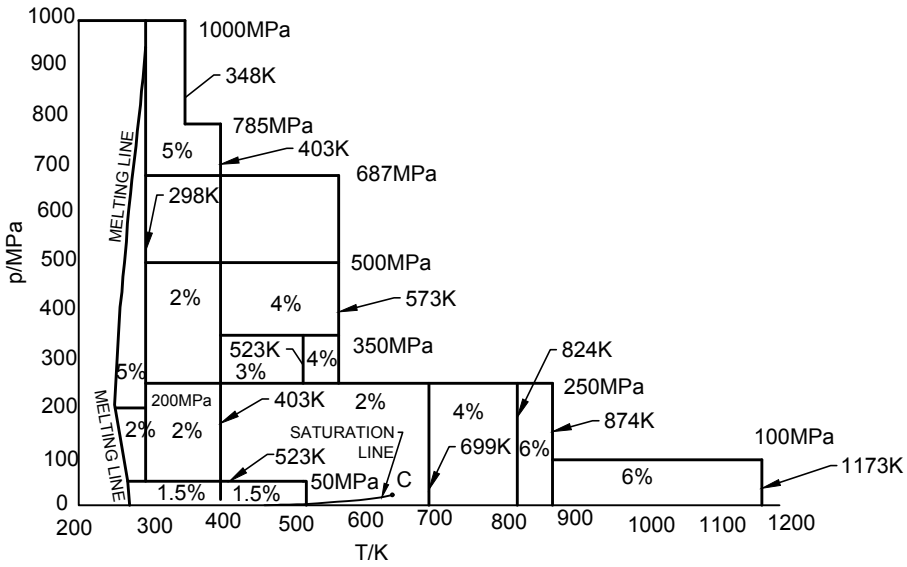



FIG. 8-2 ESTIMATED UNCERTAINTY OF THE CORRELATING EQUATION

$B = 235.8$ mN/m

$b = -0.625$

$\mu = 1.256$

1) *Range of Validity*

This equation is valid between the triple point (273.16 K) and reference temperature $T_c$. It is also provides reasonably accurate values when extrapolated into the supercooled region, to temperature as low as 248.15 K.

2) *Estimates of Uncertainties*

In the following Table, recommended values of the surface tension ($\sigma$) are given in column 2. The corresponding uncertainty values ($\Delta\sigma$) are mentioned in column 3. The values of surface tension calculated from this equation are mentioned in column 4 of following Table.

**Surface Tension of Ordinary Water Substance**

| (1) Temperature | (2) Surface Tension Experimental | (3) Uncertainty | (4) Surface Tension Calculated | (5) Difference |
|---|---|---|---|---|
| $t$ °C | $\sigma$ mN/m | $\Delta\sigma$ mN/m | $\sigma_{calc}$ mN/m | $\sigma_{calc} - \sigma$ mN/m |
| 0.01 | 75.64 | 0.38 | 75.65 | 0.01 |
| 5 | 74.94 | 0.37 | 74.94 | 0.00 |
| 10 | 74.23 | 0.37 | 74.22 | –0.01 |
| 15 | 73.49 | 0.37 | 73.49 | 0.00 |
| 20 | 72.74 | 0.36 | 72.74 | 0.00 |
| 25 | 71.98 | 0.36 | 71.97 | –0.01 |
| 30 | 71.19 | 0.36 | 71.19 | 0.00 |
| 35 | 70.41 | 0.35 | 70.40 | –0.01 |
| 40 | 69.59 | 0.35 | 69.60 | 0.01 |
| 45 | 68.78 | 0.34 | 68.78 | 0.00 |
| 50 | 67.93 | 0.34 | 67.94 | 0.01 |

| (1) Temperature | (2) Surface Tension Experimental | (3) Uncertainty | (4) Surface Tension Calculated | (5) Difference |
|---|---|---|---|---|
| $t$ °C | $\sigma$ mN/m | $\Delta\sigma$ mN/m | $\sigma_{calc}$ mN/m | $\sigma_{calc}-\sigma$ mN/m |
| 55 | 67.09 | 0.34 | 67.10 | 0.01 |
| 60 | 66.24 | 0.33 | 66.24 | 0.00 |
| 65 | 65.36 | 0.33 | 65.37 | 0.01 |
| 70 | 64.47 | 0.32 | 64.48 | 0.01 |
| 75 | 63.57 | 0.32 | 63.58 | 0.01 |
| 80 | 62.68 | 0.31 | 62.67 | −0.01 |
| 85 | 61.76 | 0.31 | 61.75 | −0.01 |
| 90 | 60.82 | 0.30 | 60.82 | 0.00 |
| 95 | 59.88 | 0.30 | 59.87 | −0.01 |
| 100 | 58.92 | 0.29 | 58.91 | −0.01 |
| 105 | 57.95 | 0.29 | 57.94 | −0.01 |
| 110 | 56.97 | 0.28 | 56.96 | −0.01 |
| 115 | 55.98 | 0.28 | 55.97 | −0.01 |
| 120 | 54.97 | 0.27 | 54.97 | 0.00 |
| 125 | 53.96 | 0.27 | 53.96 | 0.00 |
| 130 | 52.94 | 0.26 | 52.93 | −0.01 |
| 135 | 51.90 | 0.26 | 51.90 | 0.00 |
| 140 | 50.86 | 0.25 | 50.86 | 0.00 |
| 145 | 49.81 | 0.25 | 49.80 | −0.01 |
| 150 | 48.75 | 0.24 | 48.74 | −0.01 |
| 155 | 47.67 | 0.24 | 47.67 | 0.00 |
| 160 | 46.58 | 0.23 | 46.59 | 0.01 |
| 165 | 45.49 | 0.23 | 45.50 | 0.01 |
| 170 | 44.40 | 0.22 | 44.41 | 0.01 |
| 175 | 43.30 | 0.22 | 43.30 | 0.00 |
| 180 | 42.19 | 0.22 | 42.19 | 0.00 |
| 185 | 41.07 | 0.22 | 41.07 | 0.00 |
| 190 | 39.95 | 0.22 | 39.95 | 0.00 |
| 195 | 38.82 | 0.22 | 38.81 | −0.01 |
| 200 | 37.68 | 0.22 | 37.67 | −0.01 |
| 205 | 36.54 | 0.22 | 36.53 | −0.01 |
| 210 | 35.40 | 0.22 | 35.38 | −0.02 |
| 215 | 34.24 | 0.22 | 34.23 | −0.01 |
| 220 | 33.09 | 0.22 | 33.07 | −0.02 |
| 225 | 31.92 | 0.22 | 31.90 | −0.02 |
| 230 | 30.76 | 0.22 | 30.74 | −0.02 |
| 235 | 29.58 | 0.22 | 29.57 | −0.01 |
| 240 | 28.40 | 0.22 | 28.39 | −0.01 |

| (1) Temperature | (2) Surface Tension Experimental | (3) Uncertainty | (4) Surface Tension Calculated | (5) Difference |
|---|---|---|---|---|
| $t$ °C | $\sigma$ mN/m | $\Delta\sigma$ mN/m | $\sigma_{calc}$ mN/m | $\sigma_{calc} - \sigma$ mN/m |
| 245 | 27.22 | 0.22 | 27.22 | 0.00 |
| 250 | 26.05 | 0.22 | 26.04 | −0.01 |
| 255 | 24.86 | 0.21 | 24.87 | 0.01 |
| 260 | 23.66 | 0.21 | 23.69 | 0.03 |
| 265 | 22.46 | 0.21 | 22.51 | 0.05 |
| 270 | 21.29 | 0.20 | 21.34 | 0.05 |
| 275 | 20.14 | 0.20 | 20.16 | 0.02 |
| 280 | 18.93 | 0.20 | 18.99 | 0.06 |
| 285 | 17.76 | 0.19 | 17.83 | 0.07 |
| 290 | 16.60 | 0.19 | 16.66 | 0.06 |
| 295 | 15.45 | 0.19 | 15.51 | 0.06 |
| 300 | 14.30 | 0.18 | 14.36 | 0.06 |
| 305 | 13.18 | 0.18 | 13.22 | 0.04 |
| 310 | 12.04 | 0.17 | 12.09 | 0.05 |
| 315 | 10.92 | 0.16 | 10.97 | 0.05 |
| 320 | 9.81 | 0.16 | 9.86 | 0.05 |
| 325 | 8.73 | 0.15 | 8.77 | 0.04 |
| 330 | 7.66 | 0.14 | 7.70 | 0.04 |
| 335 | 6.61 | 0.13 | 6.65 | 0.04 |
| 340 | 5.59 | 0.12 | 5.63 | 0.04 |
| 345 | 4.60 | 0.11 | 4.63 | 0.03 |
| 350 | 3.64 | 0.10 | 3.67 | 0.03 |
| 355 | 2.74 | 0.10 | 2.74 | 0.00 |
| 360 | 1.89 | 0.10 | 1.88 | −0.01 |
| 365 | 1.12 | 0.10 | 1.08 | −0.04 |
| 370 | 0.45 | 0.10 | 0.39 | −0.06 |

NOTES

**1** *T* denotes absolute temperature, ITS-90.

**2** The reference temperature is the critical point temperature as mentioned in 5.10.1.

**3** The values of the constants *B*, *b*, and are those presented in the release of 1976. Adjustment of the reference temperature produces values of surface tension from the equation $\mu$ for ITS-90 temperatures with improved root-mean-square deviation compared with the original equation and the surface tension values for the IPTS-68 temperatures in the release of 1976.

# ANNEX A

(Scope)

## Table T-1. Properties of Saturated Water and Steam (Temperature)

| | Pressure | Volume, $m^3/kg$ | | | Enthalpy, kJ/kg | | | Entropy, kJ/(kg·K) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | MPa | $v_L$ | $\Delta v$ | $v_V$ | $h_L$ | $\Delta h$ | $h_V$ | $s_L$ | $\Delta s$ | $s_V$ | $t$ (°C) |
| 0 | *0.000 611 2 | 0.001 000 2 | 206.14 | 206.14 | -0.042 | 2500.9 | 2500.9 | -0.0002 | 9.1559 | 9.1558 | 0 |
| 0.01 | 0.000 611 7 | 0.001 000 2 | 206.00 | 206.00 | 0.001 | 2500.9 | 2500.9 | 0.0000 | 9.1555 | 9.1555 | 0.01 |
| 1 | 0.000 657 1 | 0.001 000 1 | 192.44 | 192.44 | 4.177 | 2498.6 | 2502.7 | 0.0153 | 9.1138 | 9.1291 | 1 |
| 2 | 0.000 706 0 | 0.001 000 1 | 179.76 | 179.76 | 8.392 | 2496.2 | 2504.6 | 0.0306 | 9.0721 | 9.1027 | 2 |
| 3 | 0.000 758 1 | 0.001 000 1 | 168.01 | 168.01 | 12.604 | 2493.8 | 2506.4 | 0.0459 | 9.0306 | 9.0765 | 3 |
| 4 | 0.000 813 5 | 0.001 000 1 | 157.12 | 157.12 | 16.813 | 2491.4 | 2508.2 | 0.0611 | 8.9895 | 9.0506 | 4 |
| 5 | 0.000 872 6 | 0.001 000 1 | 147.02 | 147.02 | 21.019 | 2489.1 | 2510.1 | 0.0763 | 8.9486 | 9.0249 | 5 |
| 6 | 0.000 935 4 | 0.001 000 1 | 137.64 | 137.64 | 25.224 | 2486.7 | 2511.9 | 0.0913 | 8.9081 | 8.9994 | 6 |
| 7 | 0.001 002 | 0.001 000 1 | 128.93 | 128.93 | 29.426 | 2484.3 | 2513.7 | 0.1064 | 8.8678 | 8.9742 | 7 |
| 8 | 0.001 073 | 0.001 000 2 | 120.83 | 120.83 | 33.626 | 2481.9 | 2515.6 | 0.1213 | 8.8278 | 8.9492 | 8 |
| 9 | 0.001 148 | 0.001 000 3 | 113.31 | 113.31 | 37.824 | 2479.6 | 2517.4 | 0.1362 | 8.7882 | 8.9244 | 9 |
| 10 | 0.001 228 | 0.001 000 3 | 106.31 | 106.31 | 42.021 | 2477.2 | 2519.2 | 0.1511 | 8.7488 | 8.8998 | 10 |
| 11 | 0.001 313 | 0.001 000 4 | 99.792 | 99.793 | 46.216 | 2474.8 | 2521.1 | 0.1659 | 8.7096 | 8.8755 | 11 |
| 12 | 0.001 403 | 0.001 000 5 | 93.723 | 93.724 | 50.410 | 2472.5 | 2522.9 | 0.1806 | 8.6708 | 8.8514 | 12 |
| 13 | 0.001 498 | 0.001 000 7 | 88.069 | 88.070 | 54.602 | 2470.1 | 2524.7 | 0.1953 | 8.6322 | 8.8275 | 13 |
| 14 | 0.001 599 | 0.001 000 8 | 82.797 | 82.798 | 58.794 | 2467.7 | 2526.5 | 0.2099 | 8.5939 | 8.8038 | 14 |
| 15 | 0.001 706 | 0.001 000 9 | 77.880 | 77.881 | 62.984 | 2465.4 | 2528.4 | 0.2245 | 8.5559 | 8.7804 | 15 |
| 16 | 0.001 819 | 0.001 001 1 | 73.290 | 73.291 | 67.173 | 2463.0 | 2530.2 | 0.2390 | 8.5181 | 8.7571 | 16 |
| 17 | 0.001 938 | 0.001 001 3 | 69.005 | 69.006 | 71.361 | 2460.6 | 2532.0 | 0.2534 | 8.4806 | 8.7341 | 17 |
| 18 | 0.002 065 | 0.001 001 5 | 65.002 | 65.003 | 75.548 | 2458.3 | 2533.8 | 0.2678 | 8.4434 | 8.7112 | 18 |
| 19 | 0.002 198 | 0.001 001 6 | 61.260 | 61.261 | 79.734 | 2455.9 | 2535.7 | 0.2822 | 8.4064 | 8.6886 | 19 |
| 20 | 0.002 339 | 0.001 001 8 | 57.760 | 57.761 | 83.920 | 2453.5 | 2537.5 | 0.2965 | 8.3696 | 8.6661 | 20 |
| 21 | 0.002 488 | 0.001 002 1 | 54.486 | 54.487 | 88.105 | 2451.2 | 2539.3 | 0.3108 | 8.3331 | 8.6439 | 21 |
| 22 | 0.002 645 | 0.001 002 3 | 51.421 | 51.422 | 92.289 | 2448.8 | 2541.1 | 0.3250 | 8.2969 | 8.6218 | 22 |
| 23 | 0.002 811 | 0.001 002 5 | 48.551 | 48.552 | 96.473 | 2446.4 | 2542.9 | 0.3391 | 8.2609 | 8.6000 | 23 |
| 24 | 0.002 986 | 0.001 002 8 | 45.862 | 45.863 | 100.66 | 2444.1 | 2544.7 | 0.3532 | 8.2251 | 8.5783 | 24 |
| 25 | 0.003 170 | 0.001 003 0 | 43.340 | 43.341 | 104.84 | 2441.7 | 2546.5 | 0.3673 | 8.1895 | 8.5568 | 25 |
| 26 | 0.003 364 | 0.001 003 3 | 40.976 | 40.977 | 109.02 | 2439.3 | 2548.4 | 0.3813 | 8.1542 | 8.5355 | 26 |
| 27 | 0.003 568 | 0.001 003 5 | 38.757 | 38.758 | 113.20 | 2437.0 | 2550.2 | 0.3952 | 8.1192 | 8.5144 | 27 |
| 28 | 0.003 783 | 0.001 003 8 | 36.674 | 36.675 | 117.38 | 2434.6 | 2552.0 | 0.4091 | 8.0843 | 8.4934 | 28 |
| 29 | 0.004 009 | 0.001 004 1 | 34.718 | 34.719 | 121.56 | 2432.2 | 2553.8 | 0.4230 | 8.0497 | 8.4727 | 29 |
| 30 | 0.004 247 | 0.001 004 4 | 32.881 | 32.882 | 125.75 | 2429.8 | 2555.6 | 0.4368 | 8.0153 | 8.4521 | 30 |
| 31 | 0.004 497 | 0.001 004 7 | 31.153 | 31.154 | 129.93 | 2427.5 | 2557.4 | 0.4506 | 7.9812 | 8.4317 | 31 |
| 32 | 0.004 759 | 0.001 005 0 | 29.528 | 29.529 | 134.11 | 2425.1 | 2559.2 | 0.4643 | 7.9472 | 8.4115 | 32 |
| 33 | 0.005 035 | 0.001 005 4 | 28.000 | 28.001 | 138.29 | 2422.7 | 2561.0 | 0.4780 | 7.9135 | 8.3914 | 33 |
| 34 | 0.005 325 | 0.001 005 7 | 26.561 | 26.562 | 142.47 | 2420.3 | 2562.8 | 0.4916 | 7.8800 | 8.3715 | 34 |
| 35 | 0.005 629 | 0.001 006 0 | 25.207 | 25.208 | 146.64 | 2417.9 | 2564.6 | 0.5052 | 7.8467 | 8.3518 | 35 |
| 36 | 0.005 947 | 0.001 006 4 | 23.931 | 23.932 | 150.82 | 2415.6 | 2566.4 | 0.5187 | 7.8136 | 8.3323 | 36 |
| 37 | 0.006 282 | 0.001 006 8 | 22.728 | 22.729 | 155.00 | 2413.2 | 2568.2 | 0.5322 | 7.7807 | 8.3129 | 37 |
| 38 | 0.006 632 | 0.001 007 1 | 21.594 | 21.595 | 159.18 | 2410.8 | 2570.0 | 0.5457 | 7.7480 | 8.2936 | 38 |
| 39 | 0.007 000 | 0.001 007 5 | 20.525 | 20.526 | 163.36 | 2408.4 | 2571.8 | 0.5591 | 7.7155 | 8.2746 | 39 |
| 40 | 0.007 384 | 0.001 007 9 | 19.516 | 19.517 | 167.54 | 2406.0 | 2573.5 | 0.5724 | 7.6832 | 8.2557 | 40 |
| 41 | 0.007 787 | 0.001 008 3 | 18.564 | 18.565 | 171.72 | 2403.6 | 2575.3 | 0.5858 | 7.6512 | 8.2369 | 41 |
| 42 | 0.008 209 | 0.001 008 7 | 17.664 | 17.665 | 175.90 | 2401.2 | 2577.1 | 0.5990 | 7.6193 | 8.2183 | 42 |
| 43 | 0.008 650 | 0.001 009 1 | 16.815 | 16.816 | 180.08 | 2398.8 | 2578.9 | 0.6123 | 7.5876 | 8.1999 | 43 |
| 44 | 0.009 112 | 0.001 009 5 | 16.012 | 16.013 | 184.26 | 2396.4 | 2580.7 | 0.6255 | 7.5561 | 8.1816 | 44 |
| 45 | 0.009 594 | 0.001 009 9 | 15.252 | 15.253 | 188.44 | 2394.0 | 2582.5 | 0.6386 | 7.5248 | 8.1634 | 45 |
| 46 | 0.010 099 | 0.001 010 3 | 14.534 | 14.535 | 192.62 | 2391.6 | 2584.2 | 0.6517 | 7.4937 | 8.1454 | 46 |
| 47 | 0.010 626 | 0.001 010 8 | 13.855 | 13.856 | 196.80 | 2389.2 | 2586.0 | 0.6648 | 7.4628 | 8.1276 | 47 |
| 48 | 0.011 176 | 0.001 011 2 | 13.212 | 13.213 | 200.98 | 2386.8 | 2587.8 | 0.6778 | 7.4320 | 8.1099 | 48 |
| 49 | 0.011 751 | 0.001 011 7 | 12.603 | 12.604 | 205.16 | 2384.4 | 2589.5 | 0.6908 | 7.4015 | 8.0923 | 49 |
| 50 | 0.012 351 | 0.001 012 1 | 12.027 | 12.028 | 209.34 | 2382.0 | 2591.3 | 0.7038 | 7.3711 | 8.0749 | 50 |
| 51 | 0.012 977 | 0.001 012 6 | 11.481 | 11.482 | 213.52 | 2379.6 | 2593.1 | 0.7167 | 7.3409 | 8.0576 | 51 |
| 52 | 0.013 631 | 0.001 013 1 | 10.963 | 10.964 | 217.70 | 2377.1 | 2594.8 | 0.7296 | 7.3109 | 8.0405 | 52 |
| 53 | 0.014 312 | 0.001 013 6 | 10.472 | 10.473 | 221.88 | 2374.7 | 2596.6 | 0.7424 | 7.2811 | 8.0235 | 53 |
| 54 | 0.015 022 | 0.001 014 0 | 10.006 | 10.007 | 226.06 | 2372.3 | 2598.4 | 0.7552 | 7.2514 | 8.0066 | 54 |
| 55 | 0.015 761 | 0.001 014 5 | 9.5639 | 9.5649 | 230.24 | 2369.9 | 2600.1 | 0.7680 | 7.2219 | 7.9899 | 55 |

**Values in italics indicate points where the thermodynamic equilibrium state is a solid; computed values are for the metastable liquid.*

## Table T-1. Properties of Saturated Water and Steam (Temperature) (cont'd)

| $t$ (°C) | Pressure MPa | Volume, m³/kg $v_L$ | $\Delta v$ | $v_V$ | Enthalpy, kJ/kg $h_L$ | $\Delta h$ | $h_V$ | Entropy, kJ/(kg·K) $s_L$ | $\Delta s$ | $s_V$ | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 56 | 0.016 532 | 0.001 015 0 | 9.1444 | 9.1454 | 234.42 | 2367.4 | 2601.9 | 0.7807 | 7.1926 | 7.9733 | 56 |
| 57 | 0.017 335 | 0.001 015 5 | 8.7461 | 8.7471 | 238.61 | 2365.0 | 2603.6 | 0.7934 | 7.1634 | 7.9568 | 57 |
| 58 | 0.018 171 | 0.001 016 1 | 8.3678 | 8.3688 | 242.79 | 2362.6 | 2605.4 | 0.8060 | 7.1344 | 7.9405 | 58 |
| 59 | 0.019 041 | 0.001 016 6 | 8.0083 | 8.0093 | 246.97 | 2360.1 | 2607.1 | 0.8186 | 7.1056 | 7.9243 | 59 |
| 60 | 0.019 946 | 0.001 017 1 | 7.6666 | 7.6677 | 251.15 | 2357.7 | 2608.8 | 0.8312 | 7.0770 | 7.9082 | 60 |
| 61 | 0.020 887 | 0.001 017 6 | 7.3418 | 7.3428 | 255.34 | 2355.2 | 2610.6 | 0.8438 | 7.0485 | 7.8922 | 61 |
| 62 | 0.021 866 | 0.001 018 2 | 7.0328 | 7.0338 | 259.52 | 2352.8 | 2612.3 | 0.8563 | 7.0201 | 7.8764 | 62 |
| 63 | 0.022 884 | 0.001 018 7 | 6.7389 | 6.7399 | 263.71 | 2350.3 | 2614.1 | 0.8687 | 6.9919 | 7.8607 | 63 |
| 64 | 0.023 942 | 0.001 019 3 | 6.4591 | 6.4601 | 267.89 | 2347.9 | 2615.8 | 0.8811 | 6.9639 | 7.8451 | 64 |
| 65 | 0.025 041 | 0.001 019 9 | 6.1928 | 6.1938 | 272.08 | 2345.4 | 2617.5 | 0.8935 | 6.9361 | 7.8296 | 65 |
| 66 | 0.026 183 | 0.001 020 4 | 5.9392 | 5.9402 | 276.27 | 2343.0 | 2619.2 | 0.9059 | 6.9083 | 7.8142 | 66 |
| 67 | 0.027 368 | 0.001 021 0 | 5.6976 | 5.6986 | 280.45 | 2340.5 | 2621.0 | 0.9182 | 6.8808 | 7.7990 | 67 |
| 68 | 0.028 599 | 0.001 021 6 | 5.4674 | 5.4684 | 284.64 | 2338.0 | 2622.7 | 0.9305 | 6.8534 | 7.7839 | 68 |
| 69 | 0.029 876 | 0.001 022 2 | 5.2479 | 5.2490 | 288.83 | 2335.6 | 2624.4 | 0.9428 | 6.8261 | 7.7689 | 69 |
| 70 | 0.031 201 | 0.001 022 8 | 5.0387 | 5.0397 | 293.02 | 2333.1 | 2626.1 | 0.9550 | 6.7990 | 7.7540 | 70 |
| 71 | 0.032 575 | 0.001 023 4 | 4.8392 | 4.8402 | 297.21 | 2330.6 | 2627.8 | 0.9672 | 6.7720 | 7.7392 | 71 |
| 72 | 0.034 000 | 0.001 024 0 | 4.6488 | 4.6498 | 301.40 | 2328.1 | 2629.5 | 0.9793 | 6.7452 | 7.7245 | 72 |
| 73 | 0.035 478 | 0.001 024 6 | 4.4671 | 4.4681 | 305.59 | 2325.6 | 2631.2 | 0.9915 | 6.7185 | 7.7100 | 73 |
| 74 | 0.037 009 | 0.001 025 2 | 4.2937 | 4.2947 | 309.78 | 2323.1 | 2632.9 | 1.0035 | 6.6920 | 7.6955 | 74 |
| 75 | 0.038 595 | 0.001 025 8 | 4.1281 | 4.1291 | 313.97 | 2320.6 | 2634.6 | 1.0156 | 6.6656 | 7.6812 | 75 |
| 76 | 0.040 239 | 0.001 026 5 | 3.9699 | 3.9709 | 318.17 | 2318.1 | 2636.3 | 1.0276 | 6.6393 | 7.6669 | 76 |
| 77 | 0.041 941 | 0.001 027 1 | 3.8188 | 3.8198 | 322.36 | 2315.6 | 2638.0 | 1.0396 | 6.6132 | 7.6528 | 77 |
| 78 | 0.043 703 | 0.001 027 7 | 3.6743 | 3.6754 | 326.56 | 2313.1 | 2639.7 | 1.0516 | 6.5872 | 7.6388 | 78 |
| 79 | 0.045 527 | 0.001 028 4 | 3.5363 | 3.5373 | 330.75 | 2310.6 | 2641.3 | 1.0635 | 6.5613 | 7.6248 | 79 |
| 80 | 0.047 415 | 0.001 029 0 | 3.4042 | 3.4053 | 334.95 | 2308.1 | 2643.0 | 1.0754 | 6.5356 | 7.6110 | 80 |
| 81 | 0.049 368 | 0.001 029 7 | 3.2780 | 3.2790 | 339.15 | 2305.5 | 2644.7 | 1.0873 | 6.5100 | 7.5973 | 81 |
| 82 | 0.051 387 | 0.001 030 4 | 3.1572 | 3.1582 | 343.34 | 2303.0 | 2646.4 | 1.0991 | 6.4846 | 7.5837 | 82 |
| 83 | 0.053 476 | 0.001 031 0 | 3.0415 | 3.0426 | 347.54 | 2300.5 | 2648.0 | 1.1109 | 6.4592 | 7.5701 | 83 |
| 84 | 0.055 636 | 0.001 031 7 | 2.9309 | 2.9319 | 351.74 | 2297.9 | 2649.7 | 1.1227 | 6.4340 | 7.5567 | 84 |
| 85 | 0.057 867 | 0.001 032 4 | 2.8249 | 2.8259 | 355.95 | 2295.4 | 2651.3 | 1.1344 | 6.4090 | 7.5434 | 85 |
| 86 | 0.060 174 | 0.001 033 1 | 2.7234 | 2.7244 | 360.15 | 2292.8 | 2653.0 | 1.1461 | 6.3840 | 7.5301 | 86 |
| 87 | 0.062 556 | 0.001 033 8 | 2.6262 | 2.6272 | 364.35 | 2290.3 | 2654.6 | 1.1578 | 6.3592 | 7.5170 | 87 |
| 88 | 0.065 017 | 0.001 034 5 | 2.5330 | 2.5341 | 368.56 | 2287.7 | 2656.3 | 1.1694 | 6.3345 | 7.5039 | 88 |
| 89 | 0.067 559 | 0.001 035 2 | 2.4437 | 2.4448 | 372.76 | 2285.1 | 2657.9 | 1.1811 | 6.3099 | 7.4909 | 89 |
| 90 | 0.070 182 | 0.001 035 9 | 2.3581 | 2.3591 | 376.97 | 2282.6 | 2659.5 | 1.1927 | 6.2854 | 7.4781 | 90 |
| 91 | 0.072 890 | 0.001 036 7 | 2.2760 | 2.2771 | 381.18 | 2280.0 | 2661.2 | 1.2042 | 6.2611 | 7.4653 | 91 |
| 92 | 0.075 685 | 0.001 037 4 | 2.1973 | 2.1983 | 385.38 | 2277.4 | 2662.8 | 1.2158 | 6.2368 | 7.4526 | 92 |
| 93 | 0.078 568 | 0.001 038 1 | 2.1217 | 2.1228 | 389.59 | 2274.8 | 2664.4 | 1.2273 | 6.2127 | 7.4400 | 93 |
| 94 | 0.081 542 | 0.001 038 9 | 2.0492 | 2.0502 | 393.81 | 2272.2 | 2666.0 | 1.2387 | 6.1887 | 7.4275 | 94 |
| 95 | 0.084 609 | 0.001 039 6 | 1.9796 | 1.9806 | 398.02 | 2269.6 | 2667.6 | 1.2502 | 6.1648 | 7.4150 | 95 |
| 96 | 0.087 771 | 0.001 040 4 | 1.9128 | 1.9138 | 402.23 | 2267.0 | 2669.2 | 1.2616 | 6.1411 | 7.4027 | 96 |
| 97 | 0.091 031 | 0.001 041 1 | 1.8486 | 1.8497 | 406.45 | 2264.4 | 2670.8 | 1.2730 | 6.1174 | 7.3904 | 97 |
| 98 | 0.094 390 | 0.001 041 9 | 1.7870 | 1.7880 | 410.66 | 2261.7 | 2672.4 | 1.2844 | 6.0938 | 7.3782 | 98 |
| 99 | 0.097 852 | 0.001 042 7 | 1.7277 | 1.7288 | 414.88 | 2259.1 | 2674.0 | 1.2957 | 6.0704 | 7.3661 | 99 |
| 100 | 0.101 42 | 0.001 043 5 | 1.6708 | 1.6719 | 419.10 | 2256.5 | 2675.6 | 1.3070 | 6.0471 | 7.3541 | 100 |
| 101 | 0.105 09 | 0.001 044 2 | 1.6161 | 1.6171 | 423.32 | 2253.8 | 2677.1 | 1.3183 | 6.0238 | 7.3421 | 101 |
| 102 | 0.108 87 | 0.001 045 0 | 1.5635 | 1.5645 | 427.54 | 2251.2 | 2678.7 | 1.3296 | 6.0007 | 7.3303 | 102 |
| 103 | 0.112 77 | 0.001 045 8 | 1.5129 | 1.5140 | 431.76 | 2248.5 | 2680.3 | 1.3408 | 5.9777 | 7.3185 | 103 |
| 104 | 0.116 78 | 0.001 046 6 | 1.4642 | 1.4653 | 435.99 | 2245.9 | 2681.8 | 1.3520 | 5.9548 | 7.3068 | 104 |
| 105 | 0.120 90 | 0.001 047 4 | 1.4174 | 1.4185 | 440.21 | 2243.2 | 2683.4 | 1.3632 | 5.9320 | 7.2951 | 105 |
| 106 | 0.125 15 | 0.001 048 3 | 1.3724 | 1.3734 | 444.44 | 2240.5 | 2684.9 | 1.3743 | 5.9092 | 7.2836 | 106 |
| 107 | 0.129 51 | 0.001 049 1 | 1.3290 | 1.3301 | 448.67 | 2237.8 | 2686.5 | 1.3854 | 5.8866 | 7.2721 | 107 |
| 108 | 0.134 01 | 0.001 049 9 | 1.2873 | 1.2883 | 452.90 | 2235.1 | 2688.0 | 1.3965 | 5.8641 | 7.2607 | 108 |
| 109 | 0.138 63 | 0.001 050 7 | 1.2471 | 1.2481 | 457.13 | 2232.4 | 2689.5 | 1.4076 | 5.8417 | 7.2493 | 109 |
| 110 | 0.143 38 | 0.001 051 6 | 1.2083 | 1.2094 | 461.36 | 2229.7 | 2691.1 | 1.4187 | 5.8194 | 7.2380 | 110 |
| 111 | 0.148 26 | 0.001 052 4 | 1.1710 | 1.1721 | 465.60 | 2227.0 | 2692.6 | 1.4297 | 5.7972 | 7.2268 | 111 |
| 112 | 0.153 28 | 0.001 053 3 | 1.1351 | 1.1362 | 469.83 | 2224.3 | 2694.1 | 1.4407 | 5.7750 | 7.2157 | 112 |
| 113 | 0.158 43 | 0.001 054 1 | 1.1005 | 1.1015 | 474.07 | 2221.5 | 2695.6 | 1.4517 | 5.7530 | 7.2047 | 113 |
| 114 | 0.163 73 | 0.001 055 0 | 1.0671 | 1.0681 | 478.31 | 2218.8 | 2697.1 | 1.4626 | 5.7310 | 7.1937 | 114 |
| 115 | 0.169 18 | 0.001 055 9 | 1.0349 | 1.0359 | 482.55 | 2216.0 | 2698.6 | 1.4735 | 5.7092 | 7.1827 | 115 |

## Table T-1. Properties of Saturated Water and Steam (Temperature) (cont'd)

| $t$ (°C) | Pressure MPa | Volume, m³/kg $v_L$ | $\Delta v$ | $v_V$ | Enthalpy, kJ/kg $h_L$ | $\Delta h$ | $h_V$ | Entropy, kJ/(kg·K) $s_L$ | $\Delta s$ | $s_V$ | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 116 | 0.174 77 | 0.001 056 8 | 1.0038 | 1.0049 | 486.80 | 2213.3 | 2700.1 | 1.4844 | 5.6874 | 7.1719 | 116 |
| 117 | 0.180 51 | 0.001 057 6 | 0.973 90 | 0.974 95 | 491.04 | 2210.5 | 2701.5 | 1.4953 | 5.6658 | 7.1611 | 117 |
| 118 | 0.186 40 | 0.001 058 5 | 0.945 01 | 0.946 07 | 495.29 | 2207.7 | 2703.0 | 1.5062 | 5.6442 | 7.1504 | 118 |
| 119 | 0.192 45 | 0.001 059 4 | 0.917 14 | 0.918 20 | 499.53 | 2204.9 | 2704.5 | 1.5170 | 5.6227 | 7.1397 | 119 |
| 120 | 0.198 67 | 0.001 060 3 | 0.890 24 | 0.891 30 | 503.78 | 2202.1 | 2705.9 | 1.5278 | 5.6013 | 7.1291 | 120 |
| 121 | 0.205 04 | 0.001 061 2 | 0.864 28 | 0.865 34 | 508.04 | 2199.3 | 2707.4 | 1.5386 | 5.5800 | 7.1186 | 121 |
| 122 | 0.211 58 | 0.001 062 2 | 0.839 21 | 0.840 28 | 512.29 | 2196.5 | 2708.8 | 1.5494 | 5.5587 | 7.1081 | 122 |
| 123 | 0.218 29 | 0.001 063 1 | 0.815 01 | 0.816 07 | 516.55 | 2193.7 | 2710.3 | 1.5601 | 5.5376 | 7.0977 | 123 |
| 124 | 0.225 17 | 0.001 064 0 | 0.791 63 | 0.792 69 | 520.80 | 2190.9 | 2711.7 | 1.5708 | 5.5165 | 7.0873 | 124 |
| 125 | 0.232 22 | 0.001 064 9 | 0.769 05 | 0.770 11 | 525.06 | 2188.0 | 2713.1 | 1.5815 | 5.4955 | 7.0770 | 125 |
| 126 | 0.239 46 | 0.001 065 9 | 0.747 23 | 0.748 29 | 529.32 | 2185.2 | 2714.5 | 1.5922 | 5.4746 | 7.0668 | 126 |
| 127 | 0.246 88 | 0.001 066 8 | 0.726 14 | 0.727 21 | 533.59 | 2182.3 | 2715.9 | 1.6028 | 5.4538 | 7.0566 | 127 |
| 128 | 0.254 48 | 0.001 067 8 | 0.705 76 | 0.706 83 | 537.85 | 2179.5 | 2717.3 | 1.6134 | 5.4330 | 7.0465 | 128 |
| 129 | 0.262 27 | 0.001 068 7 | 0.686 06 | 0.687 13 | 542.12 | 2176.6 | 2718.7 | 1.6240 | 5.4124 | 7.0364 | 129 |
| 130 | 0.270 26 | 0.001 069 7 | 0.667 01 | 0.668 08 | 546.39 | 2173.7 | 2720.1 | 1.6346 | 5.3918 | 7.0264 | 130 |
| 131 | 0.278 44 | 0.001 070 7 | 0.648 59 | 0.649 66 | 550.66 | 2170.8 | 2721.5 | 1.6452 | 5.3713 | 7.0165 | 131 |
| 132 | 0.286 82 | 0.001 071 7 | 0.630 78 | 0.631 85 | 554.93 | 2167.9 | 2722.8 | 1.6557 | 5.3508 | 7.0066 | 132 |
| 133 | 0.295 41 | 0.001 072 7 | 0.613 54 | 0.614 61 | 559.21 | 2165.0 | 2724.2 | 1.6662 | 5.3305 | 6.9967 | 133 |
| 134 | 0.304 20 | 0.001 073 6 | 0.596 87 | 0.597 94 | 563.49 | 2162.0 | 2725.5 | 1.6767 | 5.3102 | 6.9869 | 134 |
| 135 | 0.313 20 | 0.001 074 7 | 0.580 73 | 0.581 80 | 567.77 | 2159.1 | 2726.9 | 1.6872 | 5.2900 | 6.9772 | 135 |
| 136 | 0.322 42 | 0.001 075 7 | 0.565 11 | 0.566 18 | 572.05 | 2156.2 | 2728.2 | 1.6977 | 5.2698 | 6.9675 | 136 |
| 137 | 0.331 85 | 0.001 076 7 | 0.549 99 | 0.551 06 | 576.33 | 2153.2 | 2729.5 | 1.7081 | 5.2498 | 6.9579 | 137 |
| 138 | 0.341 51 | 0.001 077 7 | 0.535 35 | 0.536 42 | 580.62 | 2150.2 | 2730.8 | 1.7185 | 5.2298 | 6.9483 | 138 |
| 139 | 0.351 39 | 0.001 078 7 | 0.521 17 | 0.522 25 | 584.91 | 2147.2 | 2732.1 | 1.7289 | 5.2098 | 6.9388 | 139 |
| 140 | 0.361 50 | 0.001 079 8 | 0.507 44 | 0.508 52 | 589.20 | 2144.2 | 2733.4 | 1.7393 | 5.1900 | 6.9293 | 140 |
| 141 | 0.371 85 | 0.001 080 8 | 0.494 14 | 0.495 22 | 593.49 | 2141.2 | 2734.7 | 1.7496 | 5.1702 | 6.9198 | 141 |
| 142 | 0.382 43 | 0.001 081 9 | 0.481 25 | 0.482 33 | 597.79 | 2138.2 | 2736.0 | 1.7600 | 5.1505 | 6.9105 | 142 |
| 143 | 0.393 25 | 0.001 082 9 | 0.468 77 | 0.469 85 | 602.09 | 2135.2 | 2737.3 | 1.7703 | 5.1308 | 6.9011 | 143 |
| 144 | 0.404 32 | 0.001 084 0 | 0.456 66 | 0.457 75 | 606.39 | 2132.2 | 2738.5 | 1.7806 | 5.1112 | 6.8918 | 144 |
| 145 | 0.415 63 | 0.001 085 0 | 0.444 93 | 0.446 02 | 610.69 | 2129.1 | 2739.8 | 1.7909 | 5.0917 | 6.8826 | 145 |
| 146 | 0.427 21 | 0.001 086 1 | 0.433 56 | 0.434 65 | 615.00 | 2126.0 | 2741.0 | 1.8011 | 5.0723 | 6.8734 | 146 |
| 147 | 0.439 03 | 0.001 087 2 | 0.422 54 | 0.423 62 | 619.31 | 2123.0 | 2742.3 | 1.8114 | 5.0529 | 6.8642 | 147 |
| 148 | 0.451 12 | 0.001 088 3 | 0.411 84 | 0.412 93 | 623.62 | 2119.9 | 2743.5 | 1.8216 | 5.0335 | 6.8551 | 148 |
| 149 | 0.463 48 | 0.001 089 4 | 0.401 47 | 0.402 56 | 627.93 | 2116.8 | 2744.7 | 1.8318 | 5.0143 | 6.8461 | 149 |
| 150 | 0.476 10 | 0.001 090 5 | 0.391 41 | 0.392 50 | 632.25 | 2113.7 | 2745.9 | 1.8420 | 4.9951 | 6.8370 | 150 |
| 152 | 0.502 18 | 0.001 092 7 | 0.372 18 | 0.373 27 | 640.89 | 2107.4 | 2748.3 | 1.8623 | 4.9569 | 6.8191 | 152 |
| 154 | 0.529 38 | 0.001 095 0 | 0.354 07 | 0.355 16 | 649.55 | 2101.1 | 2750.6 | 1.8825 | 4.9189 | 6.8014 | 154 |
| 156 | 0.557 76 | 0.001 097 3 | 0.337 00 | 0.338 09 | 658.21 | 2094.7 | 2752.9 | 1.9027 | 4.8811 | 6.7838 | 156 |
| 158 | 0.587 33 | 0.001 099 6 | 0.320 90 | 0.322 00 | 666.89 | 2088.3 | 2755.2 | 1.9228 | 4.8436 | 6.7664 | 158 |
| 160 | 0.618 14 | 0.001 102 0 | 0.305 72 | 0.306 82 | 675.57 | 2081.9 | 2757.4 | 1.9428 | 4.8063 | 6.7491 | 160 |
| 162 | 0.650 22 | 0.001 104 4 | 0.291 38 | 0.292 49 | 684.28 | 2075.3 | 2759.6 | 1.9627 | 4.7693 | 6.7320 | 162 |
| 164 | 0.683 62 | 0.001 106 8 | 0.277 84 | 0.278 95 | 692.99 | 2068.8 | 2761.7 | 1.9826 | 4.7324 | 6.7150 | 164 |
| 166 | 0.718 36 | 0.001 109 3 | 0.265 05 | 0.266 16 | 701.71 | 2062.1 | 2763.8 | 2.0025 | 4.6957 | 6.6982 | 166 |
| 168 | 0.754 50 | 0.001 111 7 | 0.252 95 | 0.254 06 | 710.45 | 2055.4 | 2765.9 | 2.0222 | 4.6593 | 6.6815 | 168 |
| 170 | 0.792 05 | 0.001 114 3 | 0.241 50 | 0.242 62 | 719.21 | 2048.7 | 2767.9 | 2.0419 | 4.6230 | 6.6649 | 170 |
| 172 | 0.831 08 | 0.001 116 8 | 0.230 67 | 0.231 78 | 727.97 | 2041.9 | 2769.9 | 2.0616 | 4.5870 | 6.6485 | 172 |
| 174 | 0.871 61 | 0.001 119 4 | 0.220 41 | 0.221 53 | 736.75 | 2035.0 | 2771.8 | 2.0811 | 4.5511 | 6.6322 | 174 |
| 176 | 0.913 68 | 0.001 122 0 | 0.210 69 | 0.211 81 | 745.55 | 2028.1 | 2773.6 | 2.1007 | 4.5154 | 6.6161 | 176 |
| 178 | 0.957 34 | 0.001 124 7 | 0.201 47 | 0.202 60 | 754.36 | 2021.1 | 2775.4 | 2.1201 | 4.4799 | 6.6000 | 178 |
| 180 | 1.0026 | 0.001 127 4 | 0.192 73 | 0.193 86 | 763.19 | 2014.0 | 2777.2 | 2.1395 | 4.4445 | 6.5841 | 180 |
| 182 | 1.0496 | 0.001 130 1 | 0.184 44 | 0.185 57 | 772.03 | 2006.9 | 2778.9 | 2.1589 | 4.4094 | 6.5682 | 182 |
| 184 | 1.0983 | 0.001 132 9 | 0.176 57 | 0.177 70 | 780.89 | 1999.7 | 2780.6 | 2.1782 | 4.3743 | 6.5525 | 184 |
| 186 | 1.1487 | 0.001 135 7 | 0.169 09 | 0.170 23 | 789.76 | 1992.5 | 2782.2 | 2.1974 | 4.3395 | 6.5369 | 186 |
| 188 | 1.2009 | 0.001 138 6 | 0.161 99 | 0.163 13 | 798.66 | 1985.1 | 2783.8 | 2.2166 | 4.3048 | 6.5214 | 188 |
| 190 | 1.2550 | 0.001 141 4 | 0.155 24 | 0.156 38 | 807.57 | 1977.7 | 2785.3 | 2.2358 | 4.2702 | 6.5060 | 190 |
| 192 | 1.3110 | 0.001 144 4 | 0.148 81 | 0.149 96 | 816.49 | 1970.3 | 2786.8 | 2.2549 | 4.2358 | 6.4907 | 192 |
| 194 | 1.3689 | 0.001 147 3 | 0.142 70 | 0.143 85 | 825.44 | 1962.7 | 2788.2 | 2.2739 | 4.2015 | 6.4755 | 194 |
| 196 | 1.4288 | 0.001 150 4 | 0.136 88 | 0.138 03 | 834.40 | 1955.1 | 2789.5 | 2.2929 | 4.1674 | 6.4603 | 196 |
| 198 | 1.4907 | 0.001 153 4 | 0.131 34 | 0.132 50 | 843.39 | 1947.4 | 2790.8 | 2.3119 | 4.1334 | 6.4453 | 198 |
| 200 | 1.5547 | 0.001 156 5 | 0.126 07 | 0.127 22 | 852.39 | 1939.7 | 2792.1 | 2.3308 | 4.0995 | 6.4303 | 200 |

## Table T-1. Properties of Saturated Water and Steam (Temperature) (cont'd)

| $t$ (°C) | Pressure MPa | Volume, m³/kg $v_L$ | $\Delta v$ | $v_V$ | Enthalpy, kJ/kg $h_L$ | $\Delta h$ | $h_V$ | Entropy, kJ/(kg·K) $s_L$ | $\Delta s$ | $s_V$ | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 202 | 1.6208 | 0.001 160 | 0.121 04 | 0.122 20 | 861.42 | 1931.8 | 2793.2 | 2.3497 | 4.0657 | 6.4154 | 202 |
| 204 | 1.6891 | 0.001 163 | 0.116 24 | 0.117 40 | 870.46 | 1923.9 | 2794.4 | 2.3685 | 4.0321 | 6.4006 | 204 |
| 206 | 1.7596 | 0.001 166 | 0.111 66 | 0.112 83 | 879.53 | 1915.9 | 2795.4 | 2.3873 | 3.9985 | 6.3858 | 206 |
| 208 | 1.8323 | 0.001 169 | 0.107 30 | 0.108 47 | 888.62 | 1907.8 | 2796.4 | 2.4060 | 3.9651 | 6.3711 | 208 |
| 210 | 1.9074 | 0.001 173 | 0.103 13 | 0.104 30 | 897.73 | 1899.6 | 2797.4 | 2.4248 | 3.9318 | 6.3565 | 210 |
| 212 | 1.9848 | 0.001 176 | 0.099 15 | 0.100 32 | 906.86 | 1891.4 | 2798.2 | 2.4434 | 3.8985 | 6.3420 | 212 |
| 214 | 2.0647 | 0.001 180 | 0.095 345 | 0.096 525 | 916.02 | 1883.0 | 2799.0 | 2.4621 | 3.8654 | 6.3275 | 214 |
| 216 | 2.1470 | 0.001 183 | 0.091 710 | 0.092 893 | 925.20 | 1874.6 | 2799.8 | 2.4807 | 3.8323 | 6.3130 | 216 |
| 218 | 2.2319 | 0.001 187 | 0.088 235 | 0.089 421 | 934.41 | 1866.0 | 2800.4 | 2.4993 | 3.7993 | 6.2986 | 218 |
| 220 | 2.3193 | 0.001 190 | 0.084 911 | 0.086 101 | 943.64 | 1857.4 | 2801.1 | 2.5178 | 3.7664 | 6.2842 | 220 |
| 222 | 2.4093 | 0.001 194 | 0.081 730 | 0.082 924 | 952.90 | 1848.7 | 2801.6 | 2.5363 | 3.7336 | 6.2699 | 222 |
| 224 | 2.5020 | 0.001 198 | 0.078 685 | 0.079 883 | 962.19 | 1839.9 | 2802.1 | 2.5548 | 3.7008 | 6.2557 | 224 |
| 226 | 2.5975 | 0.001 201 | 0.075 770 | 0.076 971 | 971.50 | 1830.9 | 2802.4 | 2.5733 | 3.6681 | 6.2414 | 226 |
| 228 | 2.6957 | 0.001 205 | 0.072 977 | 0.074 182 | 980.84 | 1821.9 | 2802.8 | 2.5917 | 3.6355 | 6.2272 | 228 |
| 230 | 2.7968 | 0.001 209 | 0.070 301 | 0.071 510 | 990.21 | 1812.8 | 2803.0 | 2.6102 | 3.6029 | 6.2131 | 230 |
| 232 | 2.9008 | 0.001 213 | 0.067 736 | 0.068 949 | 999.61 | 1803.6 | 2803.2 | 2.6285 | 3.5704 | 6.1989 | 232 |
| 234 | 3.0077 | 0.001 217 | 0.065 277 | 0.066 494 | 1009.0 | 1794.2 | 2803.3 | 2.6469 | 3.5379 | 6.1848 | 234 |
| 236 | 3.1176 | 0.001 221 | 0.062 917 | 0.064 138 | 1018.5 | 1784.8 | 2803.3 | 2.6653 | 3.5054 | 6.1707 | 236 |
| 238 | 3.2306 | 0.001 225 | 0.060 654 | 0.061 879 | 1028.0 | 1775.2 | 2803.2 | 2.6836 | 3.4730 | 6.1566 | 238 |
| 240 | 3.3467 | 0.001 229 | 0.058 481 | 0.059 710 | 1037.5 | 1765.5 | 2803.1 | 2.7019 | 3.4406 | 6.1425 | 240 |
| 242 | 3.4659 | 0.001 234 | 0.056 394 | 0.057 628 | 1047.1 | 1755.7 | 2802.8 | 2.7203 | 3.4082 | 6.1285 | 242 |
| 244 | 3.5884 | 0.001 238 | 0.054 390 | 0.055 628 | 1056.7 | 1745.8 | 2802.5 | 2.7385 | 3.3759 | 6.1144 | 244 |
| 246 | 3.7142 | 0.001 243 | 0.052 465 | 0.053 707 | 1066.3 | 1735.8 | 2802.1 | 2.7568 | 3.3435 | 6.1003 | 246 |
| 248 | 3.8434 | 0.001 247 | 0.050 614 | 0.051 861 | 1076.0 | 1725.6 | 2801.6 | 2.7751 | 3.3112 | 6.0863 | 248 |
| 250 | 3.9759 | 0.001 252 | 0.048 835 | 0.050 087 | 1085.7 | 1715.3 | 2801.0 | 2.7934 | 3.2788 | 6.0722 | 250 |
| 252 | 4.1120 | 0.001 256 | 0.047 124 | 0.048 380 | 1095.4 | 1704.9 | 2800.3 | 2.8117 | 3.2465 | 6.0582 | 252 |
| 254 | 4.2515 | 0.001 261 | 0.045 477 | 0.046 739 | 1105.2 | 1694.3 | 2799.6 | 2.8299 | 3.2141 | 6.0441 | 254 |
| 256 | 4.3947 | 0.001 266 | 0.043 893 | 0.045 159 | 1115.0 | 1683.6 | 2798.7 | 2.8482 | 3.1818 | 6.0300 | 256 |
| 258 | 4.5415 | 0.001 271 | 0.042 368 | 0.043 639 | 1124.9 | 1672.8 | 2797.7 | 2.8664 | 3.1494 | 6.0158 | 258 |
| 260 | 4.6921 | 0.001 276 | 0.040 899 | 0.042 175 | 1134.8 | 1661.8 | 2796.6 | 2.8847 | 3.1170 | 6.0017 | 260 |
| 262 | 4.8464 | 0.001 281 | 0.039 485 | 0.040 766 | 1144.8 | 1650.7 | 2795.5 | 2.9030 | 3.0845 | 5.9875 | 262 |
| 264 | 5.0046 | 0.001 287 | 0.038 122 | 0.039 408 | 1154.8 | 1639.4 | 2794.2 | 2.9213 | 3.0520 | 5.9733 | 264 |
| 266 | 5.1667 | 0.001 292 | 0.036 808 | 0.038 100 | 1164.8 | 1628.0 | 2792.8 | 2.9396 | 3.0195 | 5.9590 | 266 |
| 268 | 5.3327 | 0.001 297 | 0.035 541 | 0.036 839 | 1174.9 | 1616.4 | 2791.3 | 2.9579 | 2.9869 | 5.9448 | 268 |
| 270 | 5.5028 | 0.001 303 | 0.034 319 | 0.035 622 | 1185.1 | 1604.6 | 2789.7 | 2.9762 | 2.9542 | 5.9304 | 270 |
| 272 | 5.6771 | 0.001 309 | 0.033 141 | 0.034 450 | 1195.3 | 1592.7 | 2788.0 | 2.9945 | 2.9215 | 5.9160 | 272 |
| 274 | 5.8555 | 0.001 315 | 0.032 003 | 0.033 318 | 1205.6 | 1580.6 | 2786.1 | 3.0129 | 2.8887 | 5.9016 | 274 |
| 276 | 6.0381 | 0.001 321 | 0.030 905 | 0.032 226 | 1215.9 | 1568.3 | 2784.1 | 3.0312 | 2.8558 | 5.8871 | 276 |
| 278 | 6.2251 | 0.001 327 | 0.029 845 | 0.031 172 | 1226.2 | 1555.8 | 2782.0 | 3.0496 | 2.8228 | 5.8725 | 278 |
| 280 | 6.4165 | 0.001 333 | 0.028 821 | 0.030 154 | 1236.7 | 1543.2 | 2779.8 | 3.0681 | 2.7898 | 5.8578 | 280 |
| 282 | 6.6123 | 0.001 339 | 0.027 832 | 0.029 171 | 1247.2 | 1530.3 | 2777.5 | 3.0865 | 2.7566 | 5.8431 | 282 |
| 284 | 6.8126 | 0.001 346 | 0.026 875 | 0.028 221 | 1257.7 | 1517.3 | 2775.0 | 3.1050 | 2.7232 | 5.8283 | 284 |
| 286 | 7.0176 | 0.001 352 | 0.025 950 | 0.027 303 | 1268.3 | 1504.0 | 2772.3 | 3.1236 | 2.6898 | 5.8134 | 286 |
| 288 | 7.2272 | 0.001 359 | 0.025 056 | 0.026 415 | 1279.0 | 1490.5 | 2769.6 | 3.1421 | 2.6562 | 5.7984 | 288 |
| 290 | 7.4416 | 0.001 366 | 0.024 191 | 0.025 557 | 1289.8 | 1476.8 | 2766.6 | 3.1608 | 2.6225 | 5.7832 | 290 |
| 292 | 7.6609 | 0.001 373 | 0.023 353 | 0.024 727 | 1300.6 | 1462.9 | 2763.6 | 3.1794 | 2.5886 | 5.7680 | 292 |
| 294 | 7.8850 | 0.001 381 | 0.022 542 | 0.023 923 | 1311.5 | 1448.8 | 2760.3 | 3.1982 | 2.5545 | 5.7526 | 294 |
| 296 | 8.1142 | 0.001 388 | 0.021 757 | 0.023 145 | 1322.5 | 1434.4 | 2756.9 | 3.2170 | 2.5202 | 5.7372 | 296 |
| 298 | 8.3484 | 0.001 396 | 0.020 996 | 0.022 392 | 1333.6 | 1419.7 | 2753.3 | 3.2358 | 2.4857 | 5.7215 | 298 |
| 300 | 8.5877 | 0.001 404 | 0.020 259 | 0.021 663 | 1344.8 | 1404.8 | 2749.6 | 3.2547 | 2.4510 | 5.7058 | 300 |
| 302 | 8.8323 | 0.001 412 | 0.019 544 | 0.020 956 | 1356.0 | 1389.6 | 2745.6 | 3.2737 | 2.4161 | 5.6898 | 302 |
| 304 | 9.0822 | 0.001 421 | 0.018 851 | 0.020 272 | 1367.4 | 1374.1 | 2741.5 | 3.2928 | 2.3809 | 5.6737 | 304 |
| 306 | 9.3375 | 0.001 430 | 0.018 178 | 0.019 608 | 1378.8 | 1358.4 | 2737.2 | 3.3120 | 2.3455 | 5.6575 | 306 |
| 308 | 9.5983 | 0.001 439 | 0.017 525 | 0.018 964 | 1390.4 | 1342.3 | 2732.7 | 3.3312 | 2.3098 | 5.6410 | 308 |
| 310 | 9.8647 | 0.001 448 | 0.016 891 | 0.018 339 | 1402.0 | 1325.9 | 2727.9 | 3.3506 | 2.2737 | 5.6243 | 310 |
| 312 | 10.137 | 0.001 457 | 0.016 275 | 0.017 732 | 1413.8 | 1309.2 | 2723.0 | 3.3700 | 2.2374 | 5.6074 | 312 |
| 314 | 10.415 | 0.001 467 | 0.015 676 | 0.017 144 | 1425.6 | 1292.1 | 2717.8 | 3.3896 | 2.2007 | 5.5903 | 314 |
| 316 | 10.698 | 0.001 478 | 0.015 094 | 0.016 572 | 1437.6 | 1274.7 | 2712.3 | 3.4093 | 2.1636 | 5.5729 | 316 |
| 318 | 10.988 | 0.001 488 | 0.014 528 | 0.016 016 | 1449.8 | 1256.8 | 2706.6 | 3.4291 | 2.1261 | 5.5553 | 318 |
| 320 | 11.284 | 0.001 499 | 0.013 977 | 0.015 476 | 1462.1 | 1238.6 | 2700.7 | 3.4491 | 2.0882 | 5.5373 | 320 |

## Table T-1. Properties of Saturated Water and Steam (Temperature) (cont'd)

| $t$ (°C) | Pressure MPa | Volume, m³/kg | | | Enthalpy, kJ/kg | | | Entropy, kJ/(kg·K) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $v_L$ | $\Delta v$ | $v_V$ | $h_L$ | $\Delta h$ | $h_V$ | $s_L$ | $\Delta s$ | $s_V$ | |
| 322 | 11.586 | 0.001 510 | 0.013 440 | 0.014 951 | 1474.5 | 1220.0 | 2694.4 | 3.4692 | 2.0498 | 5.5191 | 322 |
| 324 | 11.894 | 0.001 522 | 0.012 917 | 0.014 439 | 1487.0 | 1200.8 | 2687.9 | 3.4895 | 2.0110 | 5.5005 | 324 |
| 326 | 12.209 | 0.001 534 | 0.012 407 | 0.013 941 | 1499.8 | 1181.3 | 2681.0 | 3.5100 | 1.9715 | 5.4816 | 326 |
| 328 | 12.530 | 0.001 547 | 0.011 909 | 0.013 457 | 1512.7 | 1161.2 | 2673.8 | 3.5307 | 1.9316 | 5.4622 | 328 |
| 330 | 12.858 | 0.001 561 | 0.011 423 | 0.012 984 | 1525.7 | 1140.5 | 2666.2 | 3.5516 | 1.8909 | 5.4425 | 330 |
| 332 | 13.192 | 0.001 575 | 0.010 949 | 0.012 523 | 1539.0 | 1119.3 | 2658.3 | 3.5727 | 1.8496 | 5.4223 | 332 |
| 334 | 13.533 | 0.001 589 | 0.010 484 | 0.012 073 | 1552.5 | 1097.4 | 2649.9 | 3.5940 | 1.8075 | 5.4016 | 334 |
| 336 | 13.882 | 0.001 604 | 0.010 029 | 0.011 634 | 1566.2 | 1074.9 | 2641.1 | 3.6157 | 1.7646 | 5.3803 | 336 |
| 338 | 14.237 | 0.001 621 | 0.009 584 | 0.011 204 | 1580.2 | 1051.7 | 2631.9 | 3.6376 | 1.7208 | 5.3584 | 338 |
| 340 | 14.600 | 0.001 638 | 0.009 146 | 0.010 784 | 1594.4 | 1027.6 | 2622.1 | 3.6599 | 1.6760 | 5.3359 | 340 |
| 342 | 14.970 | 0.001 655 | 0.008 717 | 0.010 372 | 1609.0 | 1002.7 | 2611.7 | 3.6826 | 1.6300 | 5.3127 | 342 |
| 344 | 15.348 | 0.001 675 | 0.008 294 | 0.009 969 | 1623.9 | 976.87 | 2600.7 | 3.7058 | 1.5829 | 5.2886 | 344 |
| 346 | 15.734 | 0.001 695 | 0.007 878 | 0.009 573 | 1639.1 | 950.00 | 2589.1 | 3.7294 | 1.5344 | 5.2637 | 346 |
| 348 | 16.127 | 0.001 717 | 0.007 467 | 0.009 184 | 1654.8 | 921.99 | 2576.7 | 3.7535 | 1.4843 | 5.2378 | 348 |
| 350 | 16.529 | 0.001 740 | 0.007 061 | 0.008 801 | 1670.9 | 892.73 | 2563.6 | 3.7783 | 1.4326 | 5.2109 | 350 |
| 352 | 16.939 | 0.001 765 | 0.006 659 | 0.008 424 | 1687.5 | 862.02 | 2549.6 | 3.8039 | 1.3789 | 5.1828 | 352 |
| 354 | 17.358 | 0.001 793 | 0.006 258 | 0.008 051 | 1704.8 | 829.63 | 2534.4 | 3.8302 | 1.3229 | 5.1531 | 354 |
| 356 | 17.785 | 0.001 823 | 0.005 858 | 0.007 681 | 1722.8 | 795.33 | 2518.1 | 3.8577 | 1.2641 | 5.1218 | 356 |
| 358 | 18.221 | 0.001 857 | 0.005 456 | 0.007 313 | 1741.6 | 758.77 | 2500.4 | 3.8863 | 1.2022 | 5.0885 | 358 |
| 360 | 18.666 | 0.001 895 | 0.005 050 | 0.006 945 | 1761.5 | 719.50 | 2481.0 | 3.9164 | 1.1364 | 5.0527 | 360 |
| 361 | 18.893 | 0.001 915 | 0.004 845 | 0.006 760 | 1771.9 | 698.65 | 2470.5 | 3.9321 | 1.1017 | 5.0338 | 361 |
| 362 | 19.121 | 0.001 937 | 0.004 637 | 0.006 574 | 1782.6 | 676.87 | 2459.5 | 3.9483 | 1.0657 | 5.0140 | 362 |
| 363 | 19.352 | 0.001 961 | 0.004 425 | 0.006 387 | 1793.8 | 654.01 | 2447.8 | 3.9651 | 1.0281 | 4.9932 | 363 |
| 364 | 19.586 | 0.001 987 | 0.004 210 | 0.006 197 | 1805.4 | 629.93 | 2435.3 | 3.9827 | 0.9887 | 4.9714 | 364 |
| 365 | 19.822 | 0.002 016 | 0.003 989 | 0.006 004 | 1817.6 | 604.41 | 2422.0 | 4.0011 | 0.9471 | 4.9482 | 365 |
| 366 | 20.061 | 0.002 047 | 0.003 761 | 0.005 808 | 1830.4 | 577.19 | 2407.6 | 4.0204 | 0.9031 | 4.9235 | 366 |
| 367 | 20.302 | 0.002 082 | 0.003 524 | 0.005 606 | 1844.1 | 547.89 | 2392.0 | 4.0410 | 0.8559 | 4.8968 | 367 |
| 368 | 20.546 | 0.002 122 | 0.003 276 | 0.005 398 | 1858.8 | 515.99 | 2374.8 | 4.0631 | 0.8048 | 4.8679 | 368 |
| 369 | 20.793 | 0.002 167 | 0.003 012 | 0.005 179 | 1874.8 | 480.72 | 2355.5 | 4.0872 | 0.7486 | 4.8358 | 369 |
| 370 | 21.043 | 0.002 222 | 0.002 724 | 0.004 946 | 1892.6 | 440.86 | 2333.5 | 4.1142 | 0.6855 | 4.7996 | 370 |
| 371 | 21.296 | 0.002 290 | 0.002 401 | 0.004 691 | 1913.3 | 394.20 | 2307.5 | 4.1453 | 0.6120 | 4.7573 | 371 |
| 372 | 21.553 | 0.002 382 | 0.002 017 | 0.004 398 | 1938.5 | 336.15 | 2274.7 | 4.1836 | 0.5210 | 4.7046 | 372 |
| 373 | 21.813 | 0.002 526 | 0.001 495 | 0.004 021 | 1974.1 | 253.42 | 2227.6 | 4.2377 | 0.3922 | 4.6299 | 373 |
| 373.5 | 21.945 | 0.002 658 | 0.001 087 | 0.003 745 | 2003.0 | 186.19 | 2189.1 | 4.2818 | 0.2879 | 4.5697 | 373.5 |
| $T_c$ | 22.064 | 0.003 106 | 0. | 0.003 106 | 2087.5 | 0. | 2087.5 | 4.4120 | 0. | 4.4120 | $T_c$ |

$T_c$ = 373.946 °C

## Table T-2. Properties of Saturated Water and Steam (Pressure)

| $p$ | | Volume, $m^3/kg$ | | | Enthalpy, kJ/kg | | | Entropy, kJ/(kg·K) | | | $p$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MPa | $t$ (°C) | $v_L$ | $\Delta v$ | $v_V$ | $h_L$ | $\Delta h$ | $h_V$ | $s_L$ | $\Delta s$ | $s_V$ | MPa |
| $*p_t$ | 0.010 | 0.001 000 2 | 206.00 | 206.00 | 0.001 | 2500.9 | 2500.9 | 0.0000 | 9.1555 | 9.1555 | $*p_t$ |
| **0.0007** | 1.881 | 0.001 000 1 | 181.22 | 181.22 | 7.890 | 2496.5 | 2504.3 | 0.0288 | 9.0770 | 9.1058 | **0.0007** |
| **0.0008** | 3.761 | 0.001 000 1 | 159.65 | 159.65 | 15.809 | 2492.0 | 2507.8 | 0.0575 | 8.9992 | 9.0567 | **0.0008** |
| **0.0009** | 5.444 | 0.001 000 1 | 142.76 | 142.76 | 22.888 | 2488.0 | 2510.9 | 0.0830 | 8.9305 | 9.0135 | **0.0009** |
| **0.0010** | 6.970 | 0.001 000 1 | 129.18 | 129.18 | 29.298 | 2484.4 | 2513.7 | 0.1059 | 8.8690 | 8.9749 | **0.0010** |
| **0.0012** | 9.654 | 0.001 000 3 | 108.67 | 108.67 | 40.569 | 2478.0 | 2518.6 | 0.1460 | 8.7624 | 8.9083 | **0.0012** |
| **0.0014** | 11.969 | 0.001 000 5 | 93.902 | 93.903 | 50.282 | 2472.5 | 2522.8 | 0.1802 | 8.6720 | 8.8521 | **0.0014** |
| **0.0016** | 14.010 | 0.001 000 8 | 82.745 | 82.746 | 58.836 | 2467.7 | 2526.6 | 0.2101 | 8.5935 | 8.8036 | **0.0016** |
| **0.0018** | 15.838 | 0.001 001 1 | 74.013 | 74.014 | 66.494 | 2463.4 | 2529.9 | 0.2366 | 8.5242 | 8.7609 | **0.0018** |
| **0.0020** | 17.495 | 0.001 001 4 | 66.989 | 66.990 | 73.435 | 2459.5 | 2532.9 | 0.2606 | 8.4621 | 8.7227 | **0.0020** |
| **0.0022** | 19.013 | 0.001 001 6 | 61.212 | 61.213 | 79.790 | 2455.9 | 2535.7 | 0.2824 | 8.4059 | 8.6883 | **0.0022** |
| **0.0024** | 20.415 | 0.001 001 9 | 56.376 | 56.377 | 85.656 | 2452.6 | 2538.2 | 0.3024 | 8.3545 | 8.6569 | **0.0024** |
| **0.0026** | 21.718 | 0.001 002 2 | 52.266 | 52.267 | 91.108 | 2449.5 | 2540.6 | 0.3210 | 8.3071 | 8.6280 | **0.0026** |
| **0.0028** | 22.936 | 0.001 002 5 | 48.730 | 48.731 | 96.204 | 2446.6 | 2542.8 | 0.3382 | 8.2632 | 8.6014 | **0.0028** |
| **0.0030** | 24.080 | 0.001 002 8 | 45.654 | 45.655 | 100.99 | 2443.9 | 2544.9 | 0.3543 | 8.2222 | 8.5766 | **0.0030** |
| **0.0032** | 25.159 | 0.001 003 0 | 42.953 | 42.954 | 105.51 | 2441.3 | 2546.8 | 0.3695 | 8.1839 | 8.5534 | **0.0032** |
| **0.0034** | 26.182 | 0.001 003 3 | 40.562 | 40.563 | 109.78 | 2438.9 | 2548.7 | 0.3838 | 8.1479 | 8.5316 | **0.0034** |
| **0.0036** | 27.153 | 0.001 003 6 | 38.431 | 38.432 | 113.84 | 2436.6 | 2550.4 | 0.3973 | 8.1138 | 8.5112 | **0.0036** |
| **0.0038** | 28.078 | 0.001 003 8 | 36.518 | 36.519 | 117.71 | 2434.4 | 2552.1 | 0.4102 | 8.0816 | 8.4918 | **0.0038** |
| **0.0040** | 28.962 | 0.001 004 1 | 34.791 | 34.792 | 121.40 | 2432.3 | 2553.7 | 0.4224 | 8.0510 | 8.4735 | **0.0040** |
| **0.0042** | 29.808 | 0.001 004 4 | 33.225 | 33.226 | 124.94 | 2430.3 | 2555.2 | 0.4341 | 8.0219 | 8.4561 | **0.0042** |
| **0.0044** | 30.619 | 0.001 004 6 | 31.798 | 31.799 | 128.33 | 2428.4 | 2556.7 | 0.4453 | 7.9941 | 8.4395 | **0.0044** |
| **0.0046** | 31.400 | 0.001 004 8 | 30.492 | 30.493 | 131.60 | 2426.5 | 2558.1 | 0.4560 | 7.9676 | 8.4236 | **0.0046** |
| **0.0048** | 32.151 | 0.001 005 1 | 29.292 | 29.293 | 134.74 | 2424.7 | 2559.5 | 0.4663 | 7.9421 | 8.4084 | **0.0048** |
| **0.0050** | 32.875 | 0.001 005 3 | 28.185 | 28.186 | 137.77 | 2423.0 | 2560.8 | 0.4763 | 7.9177 | 8.3939 | **0.0050** |
| **0.0055** | 34.583 | 0.001 005 9 | 25.762 | 25.763 | 144.90 | 2418.9 | 2563.8 | 0.4995 | 7.8605 | 8.3600 | **0.0055** |
| **0.0060** | 36.160 | 0.001 006 4 | 23.733 | 23.734 | 151.49 | 2415.2 | 2566.7 | 0.5209 | 7.8083 | 8.3291 | **0.0060** |
| **0.0065** | 37.628 | 0.001 007 0 | 22.009 | 22.010 | 157.63 | 2411.7 | 2569.3 | 0.5407 | 7.7601 | 8.3008 | **0.0065** |
| **0.0070** | 39.001 | 0.001 007 5 | 20.524 | 20.525 | 163.37 | 2408.4 | 2571.8 | 0.5591 | 7.7155 | 8.2746 | **0.0070** |
| **0.0075** | 40.292 | 0.001 008 0 | 19.233 | 19.234 | 168.76 | 2405.3 | 2574.1 | 0.5763 | 7.6739 | 8.2502 | **0.0075** |
| **0.0080** | 41.510 | 0.001 008 5 | 18.098 | 18.099 | 173.85 | 2402.4 | 2576.2 | 0.5925 | 7.6349 | 8.2274 | **0.0080** |
| **0.0085** | 42.665 | 0.001 008 9 | 17.094 | 17.095 | 178.68 | 2399.6 | 2578.3 | 0.6078 | 7.5982 | 8.2060 | **0.0085** |
| **0.0090** | 43.762 | 0.001 009 4 | 16.199 | 16.200 | 183.26 | 2397.0 | 2580.3 | 0.6223 | 7.5636 | 8.1859 | **0.0090** |
| **0.0095** | 44.808 | 0.001 009 8 | 15.395 | 15.396 | 187.63 | 2394.5 | 2582.1 | 0.6361 | 7.5308 | 8.1669 | **0.0095** |
| **0.010** | 45.808 | 0.001 010 3 | 14.670 | 14.671 | 191.81 | 2392.1 | 2583.9 | 0.6492 | 7.4997 | 8.1489 | **0.010** |
| **0.011** | 47.684 | 0.001 011 1 | 13.411 | 13.412 | 199.66 | 2387.6 | 2587.2 | 0.6737 | 7.4417 | 8.1155 | **0.011** |
| **0.012** | 49.420 | 0.001 011 9 | 12.358 | 12.359 | 206.91 | 2383.4 | 2590.3 | 0.6963 | 7.3887 | 8.0850 | **0.012** |
| **0.013** | 51.035 | 0.001 012 6 | 11.462 | 11.463 | 213.66 | 2379.5 | 2593.1 | 0.7172 | 7.3399 | 8.0570 | **0.013** |
| **0.014** | 52.548 | 0.001 013 3 | 10.690 | 10.691 | 219.99 | 2375.8 | 2595.8 | 0.7366 | 7.2945 | 8.0312 | **0.014** |
| **0.015** | 53.970 | 0.001 014 0 | 10.019 | 10.020 | 225.94 | 2372.4 | 2598.3 | 0.7548 | 7.2523 | 8.0071 | **0.015** |
| **0.016** | 55.314 | 0.001 014 7 | 9.4299 | 9.4309 | 231.55 | 2369.1 | 2600.7 | 0.7720 | 7.2127 | 7.9847 | **0.016** |
| **0.017** | 56.588 | 0.001 015 3 | 8.9079 | 8.9089 | 236.88 | 2366.0 | 2602.9 | 0.7882 | 7.1754 | 7.9636 | **0.017** |
| **0.018** | 57.799 | 0.001 016 0 | 8.4423 | 8.4433 | 241.95 | 2363.1 | 2605.0 | 0.8035 | 7.1403 | 7.9437 | **0.018** |
| **0.019** | 58.954 | 0.001 016 6 | 8.0244 | 8.0254 | 246.78 | 2360.2 | 2607.0 | 0.8181 | 7.1069 | 7.9250 | **0.019** |
| **0.020** | 60.059 | 0.001 017 1 | 7.6471 | 7.6482 | 251.40 | 2357.5 | 2608.9 | 0.8320 | 7.0753 | 7.9072 | **0.020** |
| **0.022** | 62.133 | 0.001 018 3 | 6.9927 | 6.9938 | 260.08 | 2352.5 | 2612.6 | 0.8579 | 7.0164 | 7.8743 | **0.022** |
| **0.024** | 64.054 | 0.001 019 3 | 6.4445 | 6.4455 | 268.12 | 2347.8 | 2615.9 | 0.8818 | 6.9624 | 7.8442 | **0.024** |
| **0.026** | 65.843 | 0.001 020 3 | 5.9783 | 5.9793 | 275.61 | 2343.4 | 2619.0 | 0.9040 | 6.9127 | 7.8167 | **0.026** |
| **0.028** | 67.518 | 0.001 021 3 | 5.5769 | 5.5779 | 282.62 | 2339.2 | 2621.8 | 0.9246 | 6.8666 | 7.7912 | **0.028** |
| **0.030** | 69.095 | 0.001 022 2 | 5.2275 | 5.2286 | 289.23 | 2335.3 | 2624.6 | 0.9439 | 6.8235 | 7.7675 | **0.030** |
| **0.032** | 70.586 | 0.001 023 1 | 4.9206 | 4.9216 | 295.47 | 2331.6 | 2627.1 | 0.9621 | 6.7832 | 7.7453 | **0.032** |
| **0.034** | 72.000 | 0.001 024 0 | 4.6488 | 4.6498 | 301.40 | 2328.1 | 2629.5 | 0.9793 | 6.7452 | 7.7245 | **0.034** |
| **0.036** | 73.345 | 0.001 024 8 | 4.4063 | 4.4073 | 307.04 | 2324.8 | 2631.8 | 0.9956 | 6.7093 | 7.7050 | **0.036** |
| **0.038** | 74.629 | 0.001 025 6 | 4.1886 | 4.1897 | 312.42 | 2321.6 | 2634.0 | 1.0111 | 6.6754 | 7.6865 | **0.038** |
| **0.040** | 75.857 | 0.001 026 4 | 3.9921 | 3.9931 | 317.57 | 2318.5 | 2636.1 | 1.0259 | 6.6431 | 7.6690 | **0.040** |

$*p_t$ = 611.657 Pa

## Table T-2. Properties of Saturated Water and Steam (Pressure) (cont'd)

| $p$ | | Volume, $m^3/kg$ | | | Enthalpy, kJ/kg | | | Entropy, kJ/(kg·K) | | | $p$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MPa | $t$ (°C) | $v_L$ | $\Delta v$ | $v_V$ | $h_L$ | $\Delta h$ | $h_V$ | $s_L$ | $\Delta s$ | $s_V$ | MPa |
| **0.042** | 77.034 | 0.001 027 1 | 3.8137 | 3.8147 | 322.50 | 2315.5 | 2638.0 | 1.0400 | 6.6123 | 7.6523 | **0.042** |
| **0.044** | 78.165 | 0.001 027 8 | 3.6511 | 3.6521 | 327.25 | 2312.7 | 2639.9 | 1.0535 | 6.5829 | 7.6365 | **0.044** |
| **0.046** | 79.254 | 0.001 028 6 | 3.5022 | 3.5032 | 331.82 | 2309.9 | 2641.8 | 1.0665 | 6.5548 | 7.6213 | **0.046** |
| **0.048** | 80.303 | 0.001 029 2 | 3.3653 | 3.3664 | 336.22 | 2307.3 | 2643.5 | 1.0790 | 6.5279 | 7.6068 | **0.048** |
| **0.050** | 81.317 | 0.001 029 9 | 3.2391 | 3.2401 | 340.48 | 2304.7 | 2645.2 | 1.0910 | 6.5020 | 7.5930 | **0.050** |
| **0.055** | 83.709 | 0.001 031 5 | 2.9626 | 2.9636 | 350.52 | 2298.7 | 2649.2 | 1.1192 | 6.4414 | 7.5606 | **0.055** |
| **0.060** | 85.926 | 0.001 033 1 | 2.7308 | 2.7318 | 359.84 | 2293.0 | 2652.9 | 1.1452 | 6.3859 | 7.5311 | **0.060** |
| **0.065** | 87.993 | 0.001 034 5 | 2.5337 | 2.5347 | 368.53 | 2287.7 | 2656.2 | 1.1694 | 6.3346 | 7.5040 | **0.065** |
| **0.070** | 89.932 | 0.001 035 9 | 2.3639 | 2.3649 | 376.68 | 2282.7 | 2659.4 | 1.1919 | 6.2871 | 7.4790 | **0.070** |
| **0.075** | 91.758 | 0.001 037 2 | 2.2160 | 2.2171 | 384.37 | 2278.0 | 2662.4 | 1.2130 | 6.2427 | 7.4557 | **0.075** |
| **0.080** | 93.485 | 0.001 038 5 | 2.0862 | 2.0872 | 391.64 | 2273.5 | 2665.2 | 1.2328 | 6.2011 | 7.4339 | **0.080** |
| **0.085** | 95.125 | 0.001 039 7 | 1.9711 | 1.9721 | 398.55 | 2269.3 | 2667.8 | 1.2516 | 6.1618 | 7.4135 | **0.085** |
| **0.090** | 96.687 | 0.001 040 9 | 1.8684 | 1.8695 | 405.13 | 2265.2 | 2670.3 | 1.2694 | 6.1248 | 7.3942 | **0.090** |
| **0.095** | 98.178 | 0.001 042 0 | 1.7762 | 1.7773 | 411.42 | 2261.3 | 2672.7 | 1.2864 | 6.0897 | 7.3760 | **0.095** |
| **0.10** | 99.606 | 0.001 043 1 | 1.6930 | 1.6940 | 417.44 | 2257.5 | 2674.9 | 1.3026 | 6.0562 | 7.3588 | **0.10** |
| **0.11** | 102.292 | 0.001 045 3 | 1.5485 | 1.5496 | 428.77 | 2250.4 | 2679.2 | 1.3328 | 5.9940 | 7.3268 | **0.11** |
| **0.12** | 104.784 | 0.001 047 3 | 1.4274 | 1.4284 | 439.30 | 2243.8 | 2683.1 | 1.3608 | 5.9369 | 7.2976 | **0.12** |
| **0.13** | 107.109 | 0.001 049 2 | 1.3244 | 1.3254 | 449.13 | 2237.5 | 2686.6 | 1.3867 | 5.8842 | 7.2708 | **0.13** |
| **0.14** | 109.292 | 0.001 051 0 | 1.2356 | 1.2366 | 458.37 | 2231.6 | 2690.0 | 1.4109 | 5.8352 | 7.2460 | **0.14** |
| **0.15** | 111.350 | 0.001 052 7 | 1.1583 | 1.1594 | 467.08 | 2226.0 | 2693.1 | 1.4335 | 5.7894 | 7.2229 | **0.15** |
| **0.16** | 113.298 | 0.001 054 4 | 1.0904 | 1.0914 | 475.34 | 2220.7 | 2696.0 | 1.4549 | 5.7464 | 7.2014 | **0.16** |
| **0.17** | 115.149 | 0.001 056 0 | 1.0302 | 1.0312 | 483.18 | 2215.6 | 2698.8 | 1.4752 | 5.7059 | 7.1811 | **0.17** |
| **0.18** | 116.912 | 0.001 057 6 | 0.976 48 | 0.977 53 | 490.67 | 2210.7 | 2701.4 | 1.4944 | 5.6677 | 7.1620 | **0.18** |
| **0.19** | 118.597 | 0.001 059 1 | 0.928 24 | 0.929 30 | 497.82 | 2206.1 | 2703.9 | 1.5127 | 5.6313 | 7.1440 | **0.19** |
| **0.20** | 120.212 | 0.001 060 5 | 0.884 67 | 0.885 74 | 504.68 | 2201.6 | 2706.2 | 1.5301 | 5.5968 | 7.1269 | **0.20** |
| **0.21** | 121.761 | 0.001 061 9 | 0.845 13 | 0.846 19 | 511.27 | 2197.2 | 2708.5 | 1.5468 | 5.5638 | 7.1106 | **0.21** |
| **0.22** | 123.251 | 0.001 063 3 | 0.809 06 | 0.810 12 | 517.62 | 2193.0 | 2710.6 | 1.5628 | 5.5323 | 7.0951 | **0.22** |
| **0.23** | 124.688 | 0.001 064 6 | 0.776 02 | 0.777 09 | 523.73 | 2188.9 | 2712.7 | 1.5782 | 5.5021 | 7.0802 | **0.23** |
| **0.24** | 126.074 | 0.001 065 9 | 0.745 65 | 0.746 72 | 529.64 | 2185.0 | 2714.6 | 1.5930 | 5.4731 | 7.0660 | **0.24** |
| **0.25** | 127.414 | 0.001 067 2 | 0.717 63 | 0.718 70 | 535.35 | 2181.2 | 2716.5 | 1.6072 | 5.4452 | 7.0524 | **0.25** |
| **0.26** | 128.711 | 0.001 068 5 | 0.691 69 | 0.692 76 | 540.88 | 2177.4 | 2718.3 | 1.6210 | 5.4183 | 7.0393 | **0.26** |
| **0.27** | 129.968 | 0.001 069 7 | 0.667 62 | 0.668 69 | 546.25 | 2173.8 | 2720.0 | 1.6343 | 5.3924 | 7.0267 | **0.27** |
| **0.28** | 131.188 | 0.001 070 9 | 0.645 20 | 0.646 27 | 551.46 | 2170.3 | 2721.7 | 1.6472 | 5.3674 | 7.0146 | **0.28** |
| **0.29** | 132.373 | 0.001 072 0 | 0.624 28 | 0.625 36 | 556.53 | 2166.8 | 2723.3 | 1.6597 | 5.3432 | 7.0029 | **0.29** |
| **0.30** | 133.525 | 0.001 073 2 | 0.604 71 | 0.605 79 | 561.46 | 2163.4 | 2724.9 | 1.6718 | 5.3198 | 6.9916 | **0.30** |
| **0.31** | 134.647 | 0.001 074 3 | 0.586 36 | 0.587 44 | 566.26 | 2160.1 | 2726.4 | 1.6835 | 5.2971 | 6.9806 | **0.31** |
| **0.32** | 135.740 | 0.001 075 4 | 0.569 12 | 0.570 20 | 570.93 | 2156.9 | 2727.9 | 1.6950 | 5.2751 | 6.9700 | **0.32** |
| **0.33** | 136.806 | 0.001 076 5 | 0.552 89 | 0.553 97 | 575.50 | 2153.8 | 2729.3 | 1.7061 | 5.2537 | 6.9597 | **0.33** |
| **0.34** | 137.845 | 0.001 077 5 | 0.537 58 | 0.538 66 | 579.96 | 2150.7 | 2730.6 | 1.7169 | 5.2329 | 6.9498 | **0.34** |
| **0.35** | 138.861 | 0.001 078 6 | 0.523 12 | 0.524 20 | 584.31 | 2147.7 | 2732.0 | 1.7275 | 5.2126 | 6.9401 | **0.35** |
| **0.36** | 139.853 | 0.001 079 6 | 0.509 43 | 0.510 51 | 588.57 | 2144.7 | 2733.3 | 1.7378 | 5.1929 | 6.9307 | **0.36** |
| **0.37** | 140.823 | 0.001 080 6 | 0.496 46 | 0.497 54 | 592.74 | 2141.8 | 2734.5 | 1.7478 | 5.1737 | 6.9215 | **0.37** |
| **0.38** | 141.773 | 0.001 081 6 | 0.484 15 | 0.485 23 | 596.81 | 2138.9 | 2735.7 | 1.7576 | 5.1550 | 6.9126 | **0.38** |
| **0.39** | 142.702 | 0.001 082 6 | 0.472 44 | 0.473 53 | 600.81 | 2136.1 | 2736.9 | 1.7672 | 5.1367 | 6.9039 | **0.39** |
| **0.40** | 143.613 | 0.001 083 6 | 0.461 31 | 0.462 39 | 604.72 | 2133.3 | 2738.1 | 1.7766 | 5.1188 | 6.8954 | **0.40** |
| **0.42** | 145.380 | 0.001 085 5 | 0.440 57 | 0.441 66 | 612.33 | 2127.9 | 2740.3 | 1.7948 | 5.0843 | 6.8791 | **0.42** |
| **0.44** | 147.081 | 0.001 087 3 | 0.421 66 | 0.422 75 | 619.66 | 2122.7 | 2742.4 | 1.8122 | 5.0513 | 6.8635 | **0.44** |
| **0.46** | 148.721 | 0.001 089 1 | 0.404 34 | 0.405 43 | 626.73 | 2117.6 | 2744.4 | 1.8289 | 5.0197 | 6.8486 | **0.46** |
| **0.48** | 150.305 | 0.001 090 8 | 0.388 41 | 0.389 50 | 633.57 | 2112.7 | 2746.3 | 1.8450 | 4.9892 | 6.8343 | **0.48** |
| **0.50** | 151.836 | 0.001 092 6 | 0.373 71 | 0.374 80 | 640.19 | 2107.9 | 2748.1 | 1.8606 | 4.9600 | 6.8206 | **0.50** |
| **0.52** | 153.320 | 0.001 094 2 | 0.360 11 | 0.361 20 | 646.60 | 2103.2 | 2749.9 | 1.8756 | 4.9318 | 6.8074 | **0.52** |
| **0.54** | 154.758 | 0.001 095 9 | 0.347 48 | 0.348 57 | 652.83 | 2098.7 | 2751.5 | 1.8901 | 4.9045 | 6.7947 | **0.54** |
| **0.56** | 156.155 | 0.001 097 5 | 0.335 72 | 0.336 82 | 658.88 | 2094.2 | 2753.1 | 1.9042 | 4.8782 | 6.7824 | **0.56** |
| **0.58** | 157.512 | 0.001 099 1 | 0.324 74 | 0.325 84 | 664.77 | 2089.9 | 2754.7 | 1.9179 | 4.8528 | 6.7706 | **0.58** |
| **0.60** | 158.832 | 0.001 100 6 | 0.314 47 | 0.315 58 | 670.50 | 2085.6 | 2756.1 | 1.9311 | 4.8281 | 6.7592 | **0.60** |
| **0.62** | 160.118 | 0.001 102 1 | 0.304 85 | 0.305 95 | 676.09 | 2081.5 | 2757.6 | 1.9440 | 4.8041 | 6.7481 | **0.62** |
| **0.64** | 161.371 | 0.001 103 6 | 0.295 80 | 0.296 90 | 681.54 | 2077.4 | 2758.9 | 1.9565 | 4.7809 | 6.7374 | **0.64** |
| **0.66** | 162.594 | 0.001 105 1 | 0.287 28 | 0.288 39 | 686.86 | 2073.4 | 2760.2 | 1.9686 | 4.7583 | 6.7269 | **0.66** |
| **0.68** | 163.787 | 0.001 106 5 | 0.279 25 | 0.280 35 | 692.06 | 2069.5 | 2761.5 | 1.9805 | 4.7363 | 6.7168 | **0.68** |
| **0.70** | 164.953 | 0.001 108 0 | 0.271 66 | 0.272 76 | 697.14 | 2065.6 | 2762.7 | 1.9921 | 4.7149 | 6.7070 | **0.70** |

## Table T-2. Properties of Saturated Water and Steam (Pressure) (cont'd)

| $p$ | | Volume, $m^3/kg$ | | | Enthalpy, kJ/kg | | | Entropy, kJ/(kg·K) | | | $p$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MPa | $t$ (°C) | $v_L$ | $\Delta v$ | $v_V$ | $h_L$ | $\Delta h$ | $h_V$ | $s_L$ | $\Delta s$ | $s_V$ | MPa |
| 0.72 | 166.092 | 0.001 109 4 | 0.264 47 | 0.265 58 | 702.12 | 2061.8 | 2763.9 | 2.0034 | 4.6940 | 6.6974 | 0.72 |
| 0.74 | 167.207 | 0.001 110 8 | 0.257 66 | 0.258 77 | 706.99 | 2058.1 | 2765.1 | 2.0144 | 4.6737 | 6.6881 | 0.74 |
| 0.76 | 168.298 | 0.001 112 1 | 0.251 20 | 0.252 31 | 711.76 | 2054.4 | 2766.2 | 2.0252 | 4.6539 | 6.6790 | 0.76 |
| 0.78 | 169.366 | 0.001 113 5 | 0.245 06 | 0.246 17 | 716.43 | 2050.8 | 2767.3 | 2.0357 | 4.6345 | 6.6702 | 0.78 |
| 0.80 | 170.414 | 0.001 114 8 | 0.239 21 | 0.240 33 | 721.02 | 2047.3 | 2768.3 | 2.0460 | 4.6156 | 6.6615 | 0.80 |
| 0.82 | 171.440 | 0.001 116 1 | 0.233 64 | 0.234 76 | 725.52 | 2043.8 | 2769.3 | 2.0561 | 4.5970 | 6.6531 | 0.82 |
| 0.84 | 172.447 | 0.001 117 4 | 0.228 33 | 0.229 44 | 729.93 | 2040.4 | 2770.3 | 2.0659 | 4.5789 | 6.6449 | 0.84 |
| 0.86 | 173.435 | 0.001 118 7 | 0.223 25 | 0.224 37 | 734.27 | 2037.0 | 2771.2 | 2.0756 | 4.5612 | 6.6368 | 0.86 |
| 0.88 | 174.405 | 0.001 119 9 | 0.218 40 | 0.219 52 | 738.53 | 2033.6 | 2772.1 | 2.0851 | 4.5438 | 6.6289 | 0.88 |
| 0.90 | 175.358 | 0.001 121 2 | 0.213 75 | 0.214 87 | 742.72 | 2030.3 | 2773.0 | 2.0944 | 4.5268 | 6.6212 | 0.90 |
| 0.92 | 176.294 | 0.001 122 4 | 0.209 30 | 0.210 42 | 746.85 | 2027.1 | 2773.9 | 2.1035 | 4.5102 | 6.6137 | 0.92 |
| 0.94 | 177.214 | 0.001 123 6 | 0.205 03 | 0.206 16 | 750.90 | 2023.8 | 2774.7 | 2.1125 | 4.4938 | 6.6063 | 0.94 |
| 0.96 | 178.119 | 0.001 124 9 | 0.200 94 | 0.202 06 | 754.89 | 2020.7 | 2775.6 | 2.1213 | 4.4778 | 6.5991 | 0.96 |
| 0.98 | 179.010 | 0.001 126 0 | 0.197 00 | 0.198 13 | 758.82 | 2017.5 | 2776.3 | 2.1299 | 4.4620 | 6.5919 | 0.98 |
| 1.00 | 179.886 | 0.001 127 2 | 0.193 22 | 0.194 35 | 762.68 | 2014.4 | 2777.1 | 2.1384 | 4.4465 | 6.5850 | 1.00 |
| 1.05 | 182.017 | 0.001 130 1 | 0.184 37 | 0.185 50 | 772.10 | 2006.8 | 2779.0 | 2.1591 | 4.4091 | 6.5681 | 1.05 |
| 1.10 | 184.070 | 0.001 133 0 | 0.176 30 | 0.177 44 | 781.20 | 1999.5 | 2780.7 | 2.1789 | 4.3731 | 6.5520 | 1.10 |
| 1.15 | 186.050 | 0.001 135 8 | 0.168 91 | 0.170 05 | 789.99 | 1992.3 | 2782.3 | 2.1979 | 4.3386 | 6.5365 | 1.15 |
| 1.20 | 187.965 | 0.001 138 5 | 0.162 11 | 0.163 25 | 798.50 | 1985.3 | 2783.8 | 2.2163 | 4.3054 | 6.5217 | 1.20 |
| 1.25 | 189.817 | 0.001 141 2 | 0.155 84 | 0.156 98 | 806.75 | 1978.4 | 2785.2 | 2.2340 | 4.2734 | 6.5074 | 1.25 |
| 1.30 | 191.613 | 0.001 143 8 | 0.150 03 | 0.151 17 | 814.76 | 1971.7 | 2786.5 | 2.2512 | 4.2425 | 6.4936 | 1.30 |
| 1.35 | 193.355 | 0.001 146 4 | 0.144 64 | 0.145 79 | 822.55 | 1965.2 | 2787.7 | 2.2678 | 4.2126 | 6.4804 | 1.35 |
| 1.40 | 195.047 | 0.001 148 9 | 0.139 62 | 0.140 77 | 830.13 | 1958.8 | 2788.9 | 2.2839 | 4.1836 | 6.4675 | 1.40 |
| 1.45 | 196.693 | 0.001 151 4 | 0.134 93 | 0.136 08 | 837.52 | 1952.5 | 2790.0 | 2.2995 | 4.1556 | 6.4551 | 1.45 |
| 1.50 | 198.295 | 0.001 153 9 | 0.130 55 | 0.131 70 | 844.72 | 1946.3 | 2791.0 | 2.3147 | 4.1284 | 6.4431 | 1.50 |
| 1.55 | 199.856 | 0.001 156 3 | 0.126 44 | 0.127 59 | 851.74 | 1940.2 | 2792.0 | 2.3294 | 4.1019 | 6.4314 | 1.55 |
| 1.60 | 201.378 | 0.001 158 7 | 0.122 57 | 0.123 73 | 858.61 | 1934.3 | 2792.9 | 2.3438 | 4.0762 | 6.4200 | 1.60 |
| 1.65 | 202.864 | 0.001 161 0 | 0.118 94 | 0.120 10 | 865.32 | 1928.4 | 2793.7 | 2.3578 | 4.0512 | 6.4090 | 1.65 |
| 1.70 | 204.315 | 0.001 163 4 | 0.115 50 | 0.116 67 | 871.89 | 1922.6 | 2794.5 | 2.3715 | 4.0268 | 6.3983 | 1.70 |
| 1.75 | 205.733 | 0.001 165 7 | 0.112 26 | 0.113 43 | 878.32 | 1917.0 | 2795.3 | 2.3848 | 4.0030 | 6.3878 | 1.75 |
| 1.80 | 207.120 | 0.001 167 9 | 0.109 19 | 0.110 36 | 884.61 | 1911.4 | 2796.0 | 2.3978 | 3.9798 | 6.3776 | 1.80 |
| 1.85 | 208.477 | 0.001 170 2 | 0.106 29 | 0.107 46 | 890.79 | 1905.9 | 2796.6 | 2.4105 | 3.9571 | 6.3676 | 1.85 |
| 1.90 | 209.806 | 0.001 172 4 | 0.103 53 | 0.104 70 | 896.84 | 1900.4 | 2797.3 | 2.4229 | 3.9350 | 6.3579 | 1.90 |
| 1.95 | 211.108 | 0.001 174 6 | 0.100 90 | 0.102 08 | 902.79 | 1895.1 | 2797.8 | 2.4351 | 3.9133 | 6.3484 | 1.95 |
| 2.0 | 212.385 | 0.001 176 8 | 0.098 404 | 0.099 581 | 908.62 | 1889.8 | 2798.4 | 2.4470 | 3.8921 | 6.3392 | 2.0 |
| 2.1 | 214.865 | 0.001 181 0 | 0.093 753 | 0.094 934 | 919.99 | 1879.4 | 2799.4 | 2.4701 | 3.8511 | 6.3212 | 2.1 |
| 2.2 | 217.256 | 0.001 185 2 | 0.089 510 | 0.090 695 | 930.98 | 1869.2 | 2800.2 | 2.4924 | 3.8116 | 6.3040 | 2.2 |
| 2.3 | 219.564 | 0.001 189 4 | 0.085 623 | 0.086 812 | 941.63 | 1859.3 | 2800.9 | 2.5138 | 3.7736 | 6.2874 | 2.3 |
| 2.4 | 221.795 | 0.001 193 4 | 0.082 049 | 0.083 242 | 951.95 | 1849.6 | 2801.5 | 2.5344 | 3.7370 | 6.2714 | 2.4 |
| 2.5 | 223.956 | 0.001 197 4 | 0.078 750 | 0.079 947 | 961.98 | 1840.1 | 2802.0 | 2.5544 | 3.7015 | 6.2560 | 2.5 |
| 2.6 | 226.052 | 0.001 201 4 | 0.075 696 | 0.076 897 | 971.74 | 1830.7 | 2802.5 | 2.5738 | 3.6673 | 6.2411 | 2.6 |
| 2.7 | 228.086 | 0.001 205 3 | 0.072 860 | 0.074 065 | 981.24 | 1821.5 | 2802.8 | 2.5925 | 3.6341 | 6.2266 | 2.7 |
| 2.8 | 230.063 | 0.001 209 1 | 0.070 219 | 0.071 428 | 990.50 | 1812.5 | 2803.0 | 2.6107 | 3.6019 | 6.2126 | 2.8 |
| 2.9 | 231.986 | 0.001 212 9 | 0.067 754 | 0.068 967 | 999.54 | 1803.6 | 2803.2 | 2.6284 | 3.5706 | 6.1990 | 2.9 |
| 3.0 | 233.858 | 0.001 216 7 | 0.065 447 | 0.066 664 | 1008.4 | 1794.9 | 2803.3 | 2.6456 | 3.5402 | 6.1858 | 3.0 |
| 3.1 | 235.684 | 0.001 220 4 | 0.063 284 | 0.064 504 | 1017.0 | 1786.3 | 2803.3 | 2.6624 | 3.5105 | 6.1729 | 3.1 |
| 3.2 | 237.464 | 0.001 224 1 | 0.061 251 | 0.062 475 | 1025.5 | 1777.8 | 2803.2 | 2.6787 | 3.4817 | 6.1604 | 3.2 |
| 3.3 | 239.203 | 0.001 227 8 | 0.059 336 | 0.060 564 | 1033.7 | 1769.4 | 2803.1 | 2.6946 | 3.4535 | 6.1481 | 3.3 |
| 3.4 | 240.901 | 0.001 231 4 | 0.057 530 | 0.058 761 | 1041.8 | 1761.1 | 2803.0 | 2.7102 | 3.4260 | 6.1362 | 3.4 |
| 3.5 | 242.562 | 0.001 235 0 | 0.055 823 | 0.057 058 | 1049.8 | 1753.0 | 2802.7 | 2.7254 | 3.3991 | 6.1245 | 3.5 |
| 3.6 | 244.186 | 0.001 238 5 | 0.054 208 | 0.055 446 | 1057.6 | 1744.9 | 2802.5 | 2.7403 | 3.3728 | 6.1131 | 3.6 |
| 3.7 | 245.776 | 0.001 242 1 | 0.052 676 | 0.053 918 | 1065.2 | 1736.9 | 2802.1 | 2.7548 | 3.3471 | 6.1019 | 3.7 |
| 3.8 | 247.334 | 0.001 245 6 | 0.051 222 | 0.052 468 | 1072.8 | 1729.0 | 2801.8 | 2.7690 | 3.3219 | 6.0910 | 3.8 |
| 3.9 | 248.861 | 0.001 249 1 | 0.049 840 | 0.051 089 | 1080.2 | 1721.2 | 2801.4 | 2.7830 | 3.2973 | 6.0802 | 3.9 |
| 4.0 | 250.358 | 0.001 252 6 | 0.048 524 | 0.049 777 | 1087.4 | 1713.5 | 2800.9 | 2.7967 | 3.2731 | 6.0697 | 4.0 |
| 4.1 | 251.826 | 0.001 256 0 | 0.047 270 | 0.048 526 | 1094.6 | 1705.8 | 2800.4 | 2.8101 | 3.2493 | 6.0594 | 4.1 |
| 4.2 | 253.267 | 0.001 259 5 | 0.046 073 | 0.047 333 | 1101.6 | 1698.2 | 2799.9 | 2.8232 | 3.2260 | 6.0492 | 4.2 |
| 4.3 | 254.683 | 0.001 262 9 | 0.044 930 | 0.046 193 | 1108.6 | 1690.7 | 2799.3 | 2.8362 | 3.2031 | 6.0393 | 4.3 |
| 4.4 | 256.073 | 0.001 266 3 | 0.043 836 | 0.045 103 | 1115.4 | 1683.2 | 2798.7 | 2.8488 | 3.1806 | 6.0294 | 4.4 |
| 4.5 | 257.439 | 0.001 269 7 | 0.042 790 | 0.044 059 | 1122.1 | 1675.9 | 2798.0 | 2.8613 | 3.1585 | 6.0198 | 4.5 |

## Table T-2. Properties of Saturated Water and Steam (Pressure) (cont'd)

| $p$ | | Volume, $m^3/kg$ | | | Enthalpy, kJ/kg | | | Entropy, kJ/(kg·K) | | | $p$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MPa | $t$ (°C) | $v_L$ | $\Delta v$ | $v_V$ | $h_L$ | $\Delta h$ | $h_V$ | $s_L$ | $\Delta s$ | $s_V$ | MPa |
| 4.6 | 258.783 | 0.001 273 | 0.041 787 | 0.043 060 | 1128.8 | 1668.5 | 2797.3 | 2.8736 | 3.1367 | 6.0103 | 4.6 |
| 4.7 | 260.104 | 0.001 276 | 0.040 825 | 0.042 101 | 1135.3 | 1661.2 | 2796.6 | 2.8857 | 3.1153 | 6.0010 | 4.7 |
| 4.8 | 261.404 | 0.001 280 | 0.039 901 | 0.041 181 | 1141.8 | 1654.0 | 2795.8 | 2.8975 | 3.0942 | 5.9917 | 4.8 |
| 4.9 | 262.683 | 0.001 283 | 0.039 013 | 0.040 296 | 1148.2 | 1646.8 | 2795.0 | 2.9092 | 3.0734 | 5.9827 | 4.9 |
| 5.0 | 263.943 | 0.001 286 | 0.038 160 | 0.039 446 | 1154.5 | 1639.7 | 2794.2 | 2.9207 | 3.0530 | 5.9737 | 5.0 |
| 5.1 | 265.183 | 0.001 290 | 0.037 338 | 0.038 628 | 1160.7 | 1632.7 | 2793.4 | 2.9321 | 3.0328 | 5.9649 | 5.1 |
| 5.2 | 266.405 | 0.001 293 | 0.036 547 | 0.037 840 | 1166.9 | 1625.6 | 2792.5 | 2.9433 | 3.0129 | 5.9562 | 5.2 |
| 5.3 | 267.610 | 0.001 296 | 0.035 785 | 0.037 081 | 1173.0 | 1618.6 | 2791.6 | 2.9543 | 2.9933 | 5.9475 | 5.3 |
| 5.4 | 268.797 | 0.001 300 | 0.035 049 | 0.036 349 | 1179.0 | 1611.7 | 2790.7 | 2.9652 | 2.9739 | 5.9390 | 5.4 |
| 5.5 | 269.967 | 0.001 303 | 0.034 339 | 0.035 642 | 1184.9 | 1604.8 | 2789.7 | 2.9759 | 2.9548 | 5.9307 | 5.5 |
| 5.6 | 271.121 | 0.001 306 | 0.033 654 | 0.034 960 | 1190.8 | 1597.9 | 2788.7 | 2.9865 | 2.9359 | 5.9224 | 5.6 |
| 5.7 | 272.260 | 0.001 309 | 0.032 991 | 0.034 300 | 1196.6 | 1591.1 | 2787.7 | 2.9969 | 2.9173 | 5.9141 | 5.7 |
| 5.8 | 273.383 | 0.001 313 | 0.032 350 | 0.033 663 | 1202.4 | 1584.3 | 2786.7 | 3.0072 | 2.8988 | 5.9060 | 5.8 |
| 5.9 | 274.492 | 0.001 316 | 0.031 730 | 0.033 046 | 1208.1 | 1577.6 | 2785.6 | 3.0174 | 2.8806 | 5.8980 | 5.9 |
| 6.0 | 275.586 | 0.001 319 | 0.031 129 | 0.032 449 | 1213.7 | 1570.8 | 2784.6 | 3.0274 | 2.8626 | 5.8901 | 6.0 |
| 6.1 | 276.667 | 0.001 323 | 0.030 548 | 0.031 870 | 1219.3 | 1564.1 | 2783.5 | 3.0374 | 2.8448 | 5.8822 | 6.1 |
| 6.2 | 277.734 | 0.001 326 | 0.029 984 | 0.031 310 | 1224.9 | 1557.5 | 2782.3 | 3.0472 | 2.8272 | 5.8744 | 6.2 |
| 6.3 | 278.788 | 0.001 329 | 0.029 437 | 0.030 766 | 1230.3 | 1550.8 | 2781.2 | 3.0569 | 2.8098 | 5.8667 | 6.3 |
| 6.4 | 279.830 | 0.001 332 | 0.028 907 | 0.030 239 | 1235.8 | 1544.2 | 2780.0 | 3.0665 | 2.7926 | 5.8591 | 6.4 |
| 6.5 | 280.859 | 0.001 336 | 0.028 392 | 0.029 728 | 1241.2 | 1537.7 | 2778.8 | 3.0760 | 2.7755 | 5.8515 | 6.5 |
| 6.6 | 281.876 | 0.001 339 | 0.027 892 | 0.029 231 | 1246.5 | 1531.1 | 2777.6 | 3.0854 | 2.7586 | 5.8440 | 6.6 |
| 6.7 | 282.881 | 0.001 342 | 0.027 406 | 0.028 748 | 1251.8 | 1524.6 | 2776.4 | 3.0947 | 2.7419 | 5.8366 | 6.7 |
| 6.8 | 283.875 | 0.001 345 | 0.026 934 | 0.028 279 | 1257.1 | 1518.1 | 2775.1 | 3.1039 | 2.7253 | 5.8292 | 6.8 |
| 6.9 | 284.858 | 0.001 349 | 0.026 475 | 0.027 823 | 1262.3 | 1511.6 | 2773.9 | 3.1130 | 2.7089 | 5.8219 | 6.9 |
| 7.0 | 285.830 | 0.001 352 | 0.026 028 | 0.027 380 | 1267.4 | 1505.1 | 2772.6 | 3.1220 | 2.6926 | 5.8146 | 7.0 |
| 7.1 | 286.791 | 0.001 355 | 0.025 593 | 0.026 948 | 1272.6 | 1498.7 | 2771.3 | 3.1309 | 2.6765 | 5.8074 | 7.1 |
| 7.2 | 287.743 | 0.001 358 | 0.025 169 | 0.026 528 | 1277.7 | 1492.3 | 2769.9 | 3.1398 | 2.6605 | 5.8003 | 7.2 |
| 7.3 | 288.684 | 0.001 362 | 0.024 757 | 0.026 119 | 1282.7 | 1485.9 | 2768.6 | 3.1485 | 2.6447 | 5.7932 | 7.3 |
| 7.4 | 289.615 | 0.001 365 | 0.024 355 | 0.025 720 | 1287.7 | 1479.5 | 2767.2 | 3.1572 | 2.6290 | 5.7862 | 7.4 |
| 7.5 | 290.537 | 0.001 368 | 0.023 963 | 0.025 331 | 1292.7 | 1473.1 | 2765.8 | 3.1658 | 2.6134 | 5.7792 | 7.5 |
| 7.6 | 291.449 | 0.001 371 | 0.023 581 | 0.024 952 | 1297.6 | 1466.8 | 2764.4 | 3.1743 | 2.5979 | 5.7722 | 7.6 |
| 7.7 | 292.352 | 0.001 375 | 0.023 208 | 0.024 583 | 1302.5 | 1460.4 | 2763.0 | 3.1827 | 2.5826 | 5.7653 | 7.7 |
| 7.8 | 293.247 | 0.001 378 | 0.022 845 | 0.024 223 | 1307.4 | 1454.1 | 2761.5 | 3.1911 | 2.5673 | 5.7584 | 7.8 |
| 7.9 | 294.132 | 0.001 381 | 0.022 490 | 0.023 871 | 1312.3 | 1447.8 | 2760.1 | 3.1994 | 2.5522 | 5.7516 | 7.9 |
| 8.0 | 295.009 | 0.001 385 | 0.022 143 | 0.023 528 | 1317.1 | 1441.5 | 2758.6 | 3.2077 | 2.5372 | 5.7448 | 8.0 |
| 8.1 | 295.878 | 0.001 388 | 0.021 804 | 0.023 192 | 1321.9 | 1435.3 | 2757.1 | 3.2158 | 2.5223 | 5.7381 | 8.1 |
| 8.2 | 296.738 | 0.001 391 | 0.021 473 | 0.022 865 | 1326.6 | 1429.0 | 2755.6 | 3.2239 | 2.5075 | 5.7314 | 8.2 |
| 8.3 | 297.591 | 0.001 395 | 0.021 150 | 0.022 545 | 1331.3 | 1422.7 | 2754.1 | 3.2320 | 2.4928 | 5.7247 | 8.3 |
| 8.4 | 298.435 | 0.001 398 | 0.020 834 | 0.022 232 | 1336.0 | 1416.5 | 2752.5 | 3.2399 | 2.4782 | 5.7181 | 8.4 |
| 8.5 | 299.272 | 0.001 401 | 0.020 525 | 0.021 926 | 1340.7 | 1410.3 | 2751.0 | 3.2478 | 2.4637 | 5.7115 | 8.5 |
| 8.6 | 300.102 | 0.001 405 | 0.020 222 | 0.021 627 | 1345.3 | 1404.0 | 2749.4 | 3.2557 | 2.4493 | 5.7050 | 8.6 |
| 8.7 | 300.924 | 0.001 408 | 0.019 926 | 0.021 334 | 1350.0 | 1397.8 | 2747.8 | 3.2635 | 2.4349 | 5.6984 | 8.7 |
| 8.8 | 301.738 | 0.001 411 | 0.019 636 | 0.021 048 | 1354.5 | 1391.6 | 2746.2 | 3.2712 | 2.4207 | 5.6919 | 8.8 |
| 8.9 | 302.546 | 0.001 415 | 0.019 353 | 0.020 767 | 1359.1 | 1385.4 | 2744.5 | 3.2789 | 2.4065 | 5.6855 | 8.9 |
| 9.0 | 303.347 | 0.001 418 | 0.019 075 | 0.020 493 | 1363.7 | 1379.2 | 2742.9 | 3.2866 | 2.3924 | 5.6790 | 9.0 |
| 9.1 | 304.141 | 0.001 422 | 0.018 803 | 0.020 224 | 1368.2 | 1373.0 | 2741.2 | 3.2942 | 2.3784 | 5.6726 | 9.1 |
| 9.2 | 304.928 | 0.001 425 | 0.018 536 | 0.019 961 | 1372.7 | 1366.9 | 2739.5 | 3.3017 | 2.3645 | 5.6662 | 9.2 |
| 9.3 | 305.709 | 0.001 428 | 0.018 275 | 0.019 703 | 1377.1 | 1360.7 | 2737.8 | 3.3092 | 2.3507 | 5.6598 | 9.3 |
| 9.4 | 306.483 | 0.001 432 | 0.018 019 | 0.019 450 | 1381.6 | 1354.5 | 2736.1 | 3.3166 | 2.3369 | 5.6535 | 9.4 |
| 9.5 | 307.251 | 0.001 435 | 0.017 767 | 0.019 203 | 1386.0 | 1348.4 | 2734.4 | 3.3240 | 2.3232 | 5.6472 | 9.5 |
| 9.6 | 308.013 | 0.001 439 | 0.017 521 | 0.018 960 | 1390.4 | 1342.2 | 2732.6 | 3.3313 | 2.3095 | 5.6409 | 9.6 |
| 9.7 | 308.768 | 0.001 442 | 0.017 279 | 0.018 721 | 1394.8 | 1336.1 | 2730.9 | 3.3386 | 2.2960 | 5.6346 | 9.7 |
| 9.8 | 309.518 | 0.001 446 | 0.017 042 | 0.018 488 | 1399.2 | 1329.9 | 2729.1 | 3.3459 | 2.2824 | 5.6283 | 9.8 |
| 9.9 | 310.262 | 0.001 449 | 0.016 809 | 0.018 259 | 1403.5 | 1323.8 | 2727.3 | 3.3531 | 2.2690 | 5.6221 | 9.9 |
| 10.0 | 310.999 | 0.001 453 | 0.016 581 | 0.018 034 | 1407.9 | 1317.6 | 2725.5 | 3.3603 | 2.2556 | 5.6159 | 10.0 |
| 10.2 | 312.458 | 0.001 460 | 0.016 136 | 0.017 596 | 1416.5 | 1305.3 | 2721.8 | 3.3745 | 2.2290 | 5.6035 | 10.2 |
| 10.4 | 313.895 | 0.001 467 | 0.015 707 | 0.017 174 | 1425.0 | 1293.0 | 2718.0 | 3.3886 | 2.2026 | 5.5912 | 10.4 |
| 10.6 | 315.311 | 0.001 474 | 0.015 293 | 0.016 767 | 1433.5 | 1280.7 | 2714.2 | 3.4025 | 2.1764 | 5.5789 | 10.6 |
| 10.8 | 316.706 | 0.001 481 | 0.014 893 | 0.016 374 | 1441.9 | 1268.4 | 2710.3 | 3.4163 | 2.1504 | 5.5667 | 10.8 |
| 11.0 | 318.081 | 0.001 489 | 0.014 505 | 0.015 994 | 1450.3 | 1256.1 | 2706.4 | 3.4300 | 2.1246 | 5.5545 | 11.0 |

## Table T-2. Properties of Saturated Water and Steam (Pressure) (cont'd)

| $p$ | | Volume, $m^3/kg$ | | | Enthalpy, kJ/kg | | | Entropy, kJ/(kg·K) | | | $p$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MPa | $t$ (°C) | $v_L$ | $\Delta v$ | $v_V$ | $h_L$ | $\Delta h$ | $h_V$ | $s_L$ | $\Delta s$ | $s_V$ | MPa |
| 11.2 | 319.437 | 0.001 496 | 0.014 130 | 0.015 626 | 1458.6 | 1243.8 | 2702.4 | 3.4435 | 2.0989 | 5.5424 | 11.2 |
| 11.4 | 320.774 | 0.001 503 | 0.013 767 | 0.015 271 | 1466.8 | 1231.4 | 2698.3 | 3.4569 | 2.0734 | 5.5303 | 11.4 |
| 11.6 | 322.093 | 0.001 511 | 0.013 415 | 0.014 926 | 1475.0 | 1219.1 | 2694.1 | 3.4702 | 2.0480 | 5.5182 | 11.6 |
| 11.8 | 323.394 | 0.001 519 | 0.013 074 | 0.014 593 | 1483.2 | 1206.7 | 2689.9 | 3.4834 | 2.0228 | 5.5062 | 11.8 |
| 12.0 | 324.678 | 0.001 526 | 0.012 743 | 0.014 269 | 1491.3 | 1194.3 | 2685.6 | 3.4965 | 1.9977 | 5.4941 | 12.0 |
| 12.2 | 325.946 | 0.001 534 | 0.012 421 | 0.013 955 | 1499.4 | 1181.8 | 2681.2 | 3.5095 | 1.9726 | 5.4821 | 12.2 |
| 12.4 | 327.197 | 0.001 542 | 0.012 108 | 0.013 650 | 1507.5 | 1169.3 | 2676.7 | 3.5224 | 1.9477 | 5.4700 | 12.4 |
| 12.6 | 328.432 | 0.001 550 | 0.011 803 | 0.013 354 | 1515.5 | 1156.7 | 2672.2 | 3.5352 | 1.9228 | 5.4580 | 12.6 |
| 12.8 | 329.652 | 0.001 558 | 0.011 507 | 0.013 065 | 1523.4 | 1144.1 | 2667.6 | 3.5479 | 1.8980 | 5.4459 | 12.8 |
| 13.0 | 330.857 | 0.001 566 | 0.011 219 | 0.012 785 | 1531.4 | 1131.5 | 2662.9 | 3.5606 | 1.8733 | 5.4339 | 13.0 |
| 13.2 | 332.047 | 0.001 575 | 0.010 937 | 0.012 512 | 1539.3 | 1118.8 | 2658.1 | 3.5732 | 1.8486 | 5.4218 | 13.2 |
| 13.4 | 333.223 | 0.001 583 | 0.010 663 | 0.012 247 | 1547.2 | 1106.0 | 2653.2 | 3.5857 | 1.8240 | 5.4097 | 13.4 |
| 13.6 | 334.385 | 0.001 592 | 0.010 396 | 0.011 988 | 1555.1 | 1093.1 | 2648.3 | 3.5982 | 1.7993 | 5.3975 | 13.6 |
| 13.8 | 335.534 | 0.001 601 | 0.010 134 | 0.011 735 | 1563.0 | 1080.2 | 2643.2 | 3.6106 | 1.7747 | 5.3853 | 13.8 |
| 14.0 | 336.669 | 0.001 610 | 0.009 879 | 0.011 489 | 1570.9 | 1067.2 | 2638.1 | 3.6230 | 1.7500 | 5.3730 | 14.0 |
| 14.2 | 337.792 | 0.001 619 | 0.009 630 | 0.011 248 | 1578.7 | 1054.1 | 2632.9 | 3.6353 | 1.7254 | 5.3607 | 14.2 |
| 14.4 | 338.902 | 0.001 628 | 0.009 385 | 0.011 014 | 1586.6 | 1040.9 | 2627.5 | 3.6477 | 1.7007 | 5.3484 | 14.4 |
| 14.6 | 339.999 | 0.001 638 | 0.009 147 | 0.010 784 | 1594.4 | 1027.6 | 2622.1 | 3.6599 | 1.6760 | 5.3359 | 14.6 |
| 14.8 | 341.084 | 0.001 647 | 0.008 912 | 0.010 560 | 1602.3 | 1014.2 | 2616.5 | 3.6722 | 1.6512 | 5.3234 | 14.8 |
| 15.0 | 342.158 | 0.001 657 | 0.008 683 | 0.010 340 | 1610.2 | 1000.7 | 2610.9 | 3.6844 | 1.6264 | 5.3108 | 15.0 |
| 15.2 | 343.220 | 0.001 667 | 0.008 458 | 0.010 125 | 1618.0 | 987.07 | 2605.1 | 3.6967 | 1.6014 | 5.2981 | 15.2 |
| 15.4 | 344.270 | 0.001 677 | 0.008 237 | 0.009 915 | 1625.9 | 973.30 | 2599.2 | 3.7089 | 1.5764 | 5.2853 | 15.4 |
| 15.6 | 345.310 | 0.001 688 | 0.008 021 | 0.009 709 | 1633.8 | 959.39 | 2593.2 | 3.7212 | 1.5513 | 5.2724 | 15.6 |
| 15.8 | 346.339 | 0.001 699 | 0.007 808 | 0.009 506 | 1641.7 | 945.34 | 2587.1 | 3.7334 | 1.5260 | 5.2594 | 15.8 |
| 16.0 | 347.357 | 0.001 710 | 0.007 599 | 0.009 308 | 1649.7 | 931.13 | 2580.8 | 3.7457 | 1.5006 | 5.2463 | 16.0 |
| 16.2 | 348.364 | 0.001 721 | 0.007 393 | 0.009 114 | 1657.6 | 916.76 | 2574.4 | 3.7580 | 1.4750 | 5.2330 | 16.2 |
| 16.4 | 349.361 | 0.001 732 | 0.007 190 | 0.008 923 | 1665.7 | 902.22 | 2567.9 | 3.7703 | 1.4493 | 5.2196 | 16.4 |
| 16.6 | 350.349 | 0.001 744 | 0.006 991 | 0.008 736 | 1673.8 | 887.50 | 2561.2 | 3.7827 | 1.4234 | 5.2061 | 16.6 |
| 16.8 | 351.326 | 0.001 757 | 0.006 794 | 0.008 551 | 1681.9 | 872.55 | 2554.4 | 3.7952 | 1.3973 | 5.1924 | 16.8 |
| 17.0 | 352.293 | 0.001 769 | 0.006 600 | 0.008 369 | 1690.0 | 857.38 | 2547.4 | 3.8077 | 1.3708 | 5.1785 | 17.0 |
| 17.2 | 353.252 | 0.001 782 | 0.006 408 | 0.008 190 | 1698.3 | 841.96 | 2540.2 | 3.8203 | 1.3441 | 5.1644 | 17.2 |
| 17.4 | 354.200 | 0.001 796 | 0.006 218 | 0.008 014 | 1706.6 | 826.29 | 2532.9 | 3.8329 | 1.3171 | 5.1501 | 17.4 |
| 17.6 | 355.140 | 0.001 810 | 0.006 030 | 0.007 840 | 1715.0 | 810.34 | 2525.3 | 3.8457 | 1.2898 | 5.1355 | 17.6 |
| 17.8 | 356.070 | 0.001 824 | 0.005 844 | 0.007 668 | 1723.4 | 794.09 | 2517.5 | 3.8586 | 1.2620 | 5.1206 | 17.8 |
| 18.0 | 356.992 | 0.001 839 | 0.005 659 | 0.007 499 | 1732.0 | 777.51 | 2509.5 | 3.8717 | 1.2339 | 5.1055 | 18.0 |
| 18.2 | 357.905 | 0.001 855 | 0.005 476 | 0.007 331 | 1740.7 | 760.57 | 2501.3 | 3.8849 | 1.2052 | 5.0901 | 18.2 |
| 18.4 | 358.809 | 0.001 872 | 0.005 293 | 0.007 164 | 1749.5 | 743.24 | 2492.8 | 3.8982 | 1.1761 | 5.0743 | 18.4 |
| 18.6 | 359.704 | 0.001 889 | 0.005 111 | 0.006 999 | 1758.5 | 725.49 | 2484.0 | 3.9118 | 1.1464 | 5.0582 | 18.6 |
| 18.8 | 360.592 | 0.001 907 | 0.004 929 | 0.006 836 | 1767.6 | 707.27 | 2474.9 | 3.9256 | 1.1160 | 5.0416 | 18.8 |
| 19.0 | 361.471 | 0.001 925 | 0.004 747 | 0.006 673 | 1776.9 | 688.52 | 2465.4 | 3.9396 | 1.0849 | 5.0246 | 19.0 |
| 19.2 | 362.342 | 0.001 945 | 0.004 565 | 0.006 510 | 1786.4 | 669.18 | 2455.6 | 3.9540 | 1.0530 | 5.0070 | 19.2 |
| 19.4 | 363.205 | 0.001 966 | 0.004 381 | 0.006 348 | 1796.1 | 649.19 | 2445.3 | 3.9687 | 1.0202 | 4.9888 | 19.4 |
| 19.6 | 364.060 | 0.001 989 | 0.004 197 | 0.006 186 | 1806.1 | 628.46 | 2434.6 | 3.9838 | 0.9863 | 4.9700 | 19.6 |
| 19.8 | 364.907 | 0.002 013 | 0.004 010 | 0.006 022 | 1816.4 | 606.87 | 2423.3 | 3.9993 | 0.9511 | 4.9504 | 19.8 |
| 20.0 | 365.746 | 0.002 039 | 0.003 820 | 0.005 858 | 1827.1 | 584.29 | 2411.4 | 4.0154 | 0.9145 | 4.9299 | 20.0 |
| 20.2 | 366.577 | 0.002 067 | 0.003 626 | 0.005 692 | 1838.2 | 560.55 | 2398.8 | 4.0321 | 0.8762 | 4.9083 | 20.2 |
| 20.4 | 367.401 | 0.002 097 | 0.003 426 | 0.005 523 | 1849.8 | 535.43 | 2385.3 | 4.0496 | 0.8359 | 4.8855 | 20.4 |
| 20.6 | 368.218 | 0.002 131 | 0.003 220 | 0.005 351 | 1862.1 | 508.63 | 2370.8 | 4.0681 | 0.7930 | 4.8612 | 20.6 |
| 20.8 | 369.026 | 0.002 169 | 0.003 004 | 0.005 173 | 1875.2 | 479.74 | 2355.0 | 4.0879 | 0.7471 | 4.8349 | 20.8 |
| 21.0 | 369.827 | 0.002 212 | 0.002 776 | 0.004 988 | 1889.4 | 448.15 | 2337.5 | 4.1093 | 0.6970 | 4.8062 | 21.0 |
| 21.2 | 370.621 | 0.002 262 | 0.002 529 | 0.004 791 | 1905.0 | 412.91 | 2317.9 | 4.1328 | 0.6414 | 4.7742 | 21.2 |
| 21.4 | 371.406 | 0.002 324 | 0.002 255 | 0.004 579 | 1922.8 | 372.44 | 2295.2 | 4.1597 | 0.5778 | 4.7375 | 21.4 |
| 21.6 | 372.182 | 0.002 403 | 0.001 936 | 0.004 338 | 1944.0 | 323.61 | 2267.6 | 4.1918 | 0.5015 | 4.6933 | 21.6 |
| 21.8 | 372.950 | 0.002 517 | 0.001 527 | 0.004 044 | 1971.9 | 258.69 | 2230.6 | 4.2343 | 0.4004 | 4.6347 | 21.8 |
| 22.0 | 373.707 | 0.002 750 | 0.000 826 | 0.003 577 | 2021.9 | 142.27 | 2164.2 | 4.3109 | 0.2199 | 4.5308 | 22.0 |
| $p_c$ | 373.946 | 0.003 106 | 0 | 0.003 106 | 2087.5 | 0 | 2087.5 | 4.4120 | 0 | 4.4120 | $p_c$ |

$p_c$ = 22.064 MPa

## Table T-3. Properties of Superheated Steam and Compressed Water

| | 0.001 MPa ($t_{sat}$ = 6.97 °C) | | | 0.002 MPa ($t_{sat}$ = 17.50 °C) | | | 0.003 MPa ($t_{sat}$ = 24.08 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 000 1 | 29.30 | 0.1059 | 0.001 001 4 | 73.43 | 0.2606 | 0.001 002 8 | 100.99 | 0.3543 | Sat. Liq. |
| Sat. Vap. | 129.18 | 2513.7 | 8.9749 | 66.990 | 2532.9 | 8.7227 | 45.655 | 2544.9 | 8.5766 | Sat. Vap. |
| 0 | 0.001 000 2 | -0.04 | -0.0002 | 0.001 000 2 | -0.04 | -0.0002 | 0.001 000 2 | -0.04 | -0.0002 | 0 |
| 5 | 0.001 000 1 | 21.02 | 0.0763 | 0.001 000 1 | 21.02 | 0.0763 | 0.001 000 1 | 21.02 | 0.0763 | 5 |
| 10 | 130.59 | 2519.4 | 8.9953 | 0.001 000 3 | 42.02 | 0.1511 | 0.001 000 3 | 42.02 | 0.1511 | 10 |
| 15 | 132.91 | 2528.8 | 9.0282 | 0.001 000 9 | 62.98 | 0.2245 | 0.001 000 9 | 62.98 | 0.2245 | 15 |
| 20 | 135.22 | 2538.2 | 9.0604 | 67.572 | 2537.7 | 8.7390 | 0.001 001 8 | 83.92 | 0.2965 | 20 |
| 25 | 137.54 | 2547.6 | 9.0921 | 68.733 | 2547.1 | 8.7710 | 45.798 | 2546.6 | 8.5825 | 25 |
| 30 | 139.85 | 2556.9 | 9.1233 | 69.893 | 2556.5 | 8.8023 | 46.574 | 2556.1 | 8.6141 | 30 |
| 35 | 142.16 | 2566.3 | 9.1539 | 71.052 | 2565.9 | 8.8331 | 47.348 | 2565.6 | 8.6450 | 35 |
| 40 | 144.47 | 2575.7 | 9.1841 | 72.210 | 2575.3 | 8.8634 | 48.122 | 2575.0 | 8.6754 | 40 |
| 45 | 146.79 | 2585.0 | 9.2138 | 73.368 | 2584.7 | 8.8931 | 48.895 | 2584.5 | 8.7053 | 45 |
| 50 | 149.10 | 2594.4 | 9.2430 | 74.525 | 2594.1 | 8.9224 | 49.668 | 2593.9 | 8.7347 | 50 |
| 55 | 151.41 | 2603.8 | 9.2718 | 75.682 | 2603.5 | 8.9513 | 50.440 | 2603.3 | 8.7636 | 55 |
| 60 | 153.72 | 2613.2 | 9.3002 | 76.839 | 2613.0 | 8.9798 | 51.212 | 2612.7 | 8.7921 | 60 |
| 65 | 156.03 | 2622.6 | 9.3282 | 77.995 | 2622.4 | 9.0078 | 51.984 | 2622.2 | 8.8202 | 65 |
| 70 | 158.34 | 2632.0 | 9.3558 | 79.151 | 2631.8 | 9.0354 | 52.756 | 2631.6 | 8.8479 | 70 |
| 75 | 160.65 | 2641.4 | 9.3830 | 80.307 | 2641.2 | 9.0627 | 53.527 | 2641.0 | 8.8752 | 75 |
| 80 | 162.96 | 2650.8 | 9.4099 | 81.463 | 2650.6 | 9.0896 | 54.298 | 2650.5 | 8.9021 | 80 |
| 85 | 165.27 | 2660.2 | 9.4364 | 82.618 | 2660.1 | 9.1161 | 55.069 | 2659.9 | 8.9286 | 85 |
| 90 | 167.58 | 2669.6 | 9.4625 | 83.774 | 2669.5 | 9.1423 | 55.840 | 2669.4 | 8.9549 | 90 |
| 95 | 169.88 | 2679.1 | 9.4883 | 84.929 | 2679.0 | 9.1681 | 56.611 | 2678.8 | 8.9807 | 95 |
| 100 | 172.19 | 2688.5 | 9.5138 | 86.084 | 2688.4 | 9.1937 | 57.381 | 2688.3 | 9.0063 | 100 |
| 105 | 174.50 | 2698.0 | 9.5390 | 87.239 | 2697.9 | 9.2189 | 58.152 | 2697.8 | 9.0315 | 105 |
| 110 | 176.81 | 2707.5 | 9.5639 | 88.394 | 2707.4 | 9.2438 | 58.922 | 2707.3 | 9.0564 | 110 |
| 115 | 179.12 | 2717.0 | 9.5885 | 89.549 | 2716.9 | 9.2684 | 59.692 | 2716.7 | 9.0810 | 115 |
| 120 | 181.43 | 2726.4 | 9.6128 | 90.704 | 2726.3 | 9.2927 | 60.462 | 2726.3 | 9.1054 | 120 |
| 125 | 183.74 | 2735.9 | 9.6368 | 91.859 | 2735.9 | 9.3167 | 61.233 | 2735.8 | 9.1294 | 125 |
| 130 | 186.05 | 2745.5 | 9.6606 | 93.013 | 2745.4 | 9.3405 | 62.003 | 2745.3 | 9.1532 | 130 |
| 135 | 188.35 | 2755.0 | 9.6841 | 94.168 | 2754.9 | 9.3640 | 62.773 | 2754.8 | 9.1767 | 135 |
| 140 | 190.66 | 2764.5 | 9.7073 | 95.323 | 2764.5 | 9.3872 | 63.543 | 2764.4 | 9.2000 | 140 |
| 145 | 192.97 | 2774.1 | 9.7303 | 96.477 | 2774.0 | 9.4102 | 64.313 | 2773.9 | 9.2230 | 145 |
| 150 | 195.28 | 2783.6 | 9.7530 | 97.631 | 2783.6 | 9.4330 | 65.082 | 2783.5 | 9.2457 | 150 |
| 155 | 197.59 | 2793.2 | 9.7755 | 98.786 | 2793.2 | 9.4555 | 65.852 | 2793.1 | 9.2682 | 155 |
| 160 | 199.90 | 2802.8 | 9.7978 | 99.940 | 2802.7 | 9.4777 | 66.622 | 2802.7 | 9.2905 | 160 |
| 165 | 202.20 | 2812.4 | 9.8198 | 101.09 | 2812.4 | 9.4998 | 67.392 | 2812.3 | 9.3126 | 165 |
| 170 | 204.51 | 2822.0 | 9.8416 | 102.25 | 2822.0 | 9.5216 | 68.161 | 2821.9 | 9.3344 | 170 |
| 175 | 206.82 | 2831.7 | 9.8632 | 103.40 | 2831.6 | 9.5432 | 68.931 | 2831.5 | 9.3560 | 175 |
| 180 | 209.13 | 2841.3 | 9.8846 | 104.56 | 2841.2 | 9.5646 | 69.701 | 2841.2 | 9.3774 | 180 |
| 185 | 211.44 | 2851.0 | 9.9058 | 105.71 | 2850.9 | 9.5858 | 70.470 | 2850.8 | 9.3986 | 185 |
| 190 | 213.74 | 2860.6 | 9.9268 | 106.87 | 2860.6 | 9.6068 | 71.240 | 2860.5 | 9.4196 | 190 |
| 195 | 216.05 | 2870.3 | 9.9476 | 108.02 | 2870.3 | 9.6276 | 72.010 | 2870.2 | 9.4404 | 195 |
| 200 | 218.36 | 2880.0 | 9.9682 | 109.17 | 2880.0 | 9.6482 | 72.779 | 2879.9 | 9.4610 | 200 |
| 205 | 220.67 | 2889.7 | 9.9886 | 110.33 | 2889.7 | 9.6686 | 73.549 | 2889.6 | 9.4814 | 205 |
| 210 | 222.98 | 2899.4 | 10.009 | 111.48 | 2899.4 | 9.6889 | 74.318 | 2899.3 | 9.5017 | 210 |
| 215 | 225.28 | 2909.2 | 10.029 | 112.64 | 2909.1 | 9.7089 | 75.088 | 2909.1 | 9.5217 | 215 |
| 220 | 227.59 | 2918.9 | 10.049 | 113.79 | 2918.9 | 9.7288 | 75.857 | 2918.8 | 9.5416 | 220 |
| 225 | 229.90 | 2928.7 | 10.068 | 114.95 | 2928.6 | 9.7485 | 76.627 | 2928.6 | 9.5613 | 225 |
| 230 | 232.21 | 2938.5 | 10.088 | 116.10 | 2938.4 | 9.7680 | 77.396 | 2938.4 | 9.5809 | 230 |
| 235 | 234.52 | 2948.3 | 10.107 | 117.25 | 2948.2 | 9.7874 | 78.166 | 2948.2 | 9.6002 | 235 |
| 240 | 236.82 | 2958.1 | 10.127 | 118.41 | 2958.0 | 9.8066 | 78.935 | 2958.0 | 9.6194 | 240 |
| 245 | 239.13 | 2967.9 | 10.146 | 119.56 | 2967.9 | 9.8257 | 79.705 | 2967.8 | 9.6385 | 245 |
| 250 | 241.44 | 2977.7 | 10.165 | 120.72 | 2977.7 | 9.8446 | 80.474 | 2977.7 | 9.6574 | 250 |
| 255 | 243.75 | 2987.6 | 10.183 | 121.87 | 2987.6 | 9.8633 | 81.244 | 2987.5 | 9.6762 | 255 |
| 260 | 246.05 | 2997.5 | 10.202 | 123.02 | 2997.4 | 9.8819 | 82.013 | 2997.4 | 9.6948 | 260 |
| 265 | 248.36 | 3007.3 | 10.220 | 124.18 | 3007.3 | 9.9004 | 82.782 | 3007.3 | 9.7132 | 265 |
| 270 | 250.67 | 3017.2 | 10.239 | 125.33 | 3017.2 | 9.9187 | 83.552 | 3017.2 | 9.7315 | 270 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.004 MPa ($t_{sat}$ = 28.96 °C) | | | 0.005 MPa ($t_{sat}$ = 32.88 °C) | | | 0.006 MPa ($t_{sat}$ = 36.16 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 004 1 | 121.40 | 0.4224 | 0.001 005 3 | 137.77 | 0.4763 | 0.001 006 4 | 151.49 | 0.5209 | Sat. Liq. |
| Sat. Vap. | 34.792 | 2553.7 | 8.4735 | 28.186 | 2560.8 | 8.3939 | 23.734 | 2566.7 | 8.3291 | Sat. Vap. |
| 0 | 0.001 000 2 | -0.04 | -0.0002 | 0.001 000 2 | -0.04 | -0.0002 | 0.001 000 2 | -0.04 | -0.0002 | 0 |
| 5 | 0.001 000 1 | 21.02 | 0.0763 | 0.001 000 1 | 21.02 | 0.0763 | 0.001 000 1 | 21.02 | 0.0763 | 5 |
| 10 | 0.001 000 3 | 42.02 | 0.1511 | 0.001 000 3 | 42.02 | 0.1511 | 0.001 000 3 | 42.03 | 0.1511 | 10 |
| 15 | 0.001 000 9 | 62.99 | 0.2245 | 0.001 000 9 | 62.99 | 0.2245 | 0.001 000 9 | 62.99 | 0.2245 | 15 |
| 20 | 0.001 001 8 | 83.92 | 0.2965 | 0.001 001 8 | 83.92 | 0.2965 | 0.001 001 8 | 83.92 | 0.2965 | 20 |
| 25 | 0.001 003 0 | 104.84 | 0.3673 | 0.001 003 0 | 104.84 | 0.3673 | 0.001 003 0 | 104.84 | 0.3673 | 25 |
| 30 | 34.914 | 2555.7 | 8.4801 | 0.001 004 4 | 125.75 | 0.4368 | 0.001 004 4 | 125.75 | 0.4368 | 30 |
| 35 | 35.496 | 2565.2 | 8.5112 | 28.385 | 2564.8 | 8.4072 | 0.001 006 0 | 146.65 | 0.5052 | 35 |
| 40 | 36.078 | 2574.7 | 8.5418 | 28.851 | 2574.4 | 8.4379 | 24.033 | 2574.0 | 8.3528 | 40 |
| 45 | 36.659 | 2584.2 | 8.5717 | 29.317 | 2583.9 | 8.4680 | 24.422 | 2583.6 | 8.3831 | 45 |
| 50 | 37.239 | 2593.6 | 8.6012 | 29.782 | 2593.4 | 8.4976 | 24.811 | 2593.1 | 8.4127 | 50 |
| 55 | 37.819 | 2603.1 | 8.6302 | 30.247 | 2602.8 | 8.5266 | 25.198 | 2602.6 | 8.4419 | 55 |
| 60 | 38.399 | 2612.5 | 8.6588 | 30.711 | 2612.3 | 8.5553 | 25.586 | 2612.1 | 8.4706 | 60 |
| 65 | 38.979 | 2622.0 | 8.6869 | 31.175 | 2621.8 | 8.5834 | 25.973 | 2621.6 | 8.4988 | 65 |
| 70 | 39.558 | 2631.4 | 8.7146 | 31.639 | 2631.2 | 8.6112 | 26.360 | 2631.0 | 8.5266 | 70 |
| 75 | 40.137 | 2640.9 | 8.7420 | 32.103 | 2640.7 | 8.6386 | 26.747 | 2640.5 | 8.5540 | 75 |
| 80 | 40.716 | 2650.3 | 8.7689 | 32.566 | 2650.1 | 8.6656 | 27.133 | 2650.0 | 8.5811 | 80 |
| 85 | 41.294 | 2659.8 | 8.7955 | 33.030 | 2659.6 | 8.6922 | 27.520 | 2659.5 | 8.6077 | 85 |
| 90 | 41.873 | 2669.2 | 8.8218 | 33.493 | 2669.1 | 8.7185 | 27.906 | 2668.9 | 8.6340 | 90 |
| 95 | 42.451 | 2678.7 | 8.8477 | 33.956 | 2678.6 | 8.7444 | 28.292 | 2678.4 | 8.6600 | 95 |
| 100 | 43.030 | 2688.2 | 8.8732 | 34.419 | 2688.0 | 8.7700 | 28.678 | 2687.9 | 8.6856 | 100 |
| 105 | 43.608 | 2697.7 | 8.8985 | 34.881 | 2697.5 | 8.7953 | 29.064 | 2697.4 | 8.7109 | 105 |
| 110 | 44.186 | 2707.1 | 8.9234 | 35.344 | 2707.0 | 8.8202 | 29.450 | 2706.9 | 8.7358 | 110 |
| 115 | 44.764 | 2716.6 | 8.9481 | 35.807 | 2716.5 | 8.8449 | 29.835 | 2716.4 | 8.7605 | 115 |
| 120 | 45.342 | 2726.2 | 8.9724 | 36.269 | 2726.1 | 8.8692 | 30.221 | 2726.0 | 8.7849 | 120 |
| 125 | 45.920 | 2735.7 | 8.9965 | 36.732 | 2735.6 | 8.8933 | 30.606 | 2735.5 | 8.8090 | 125 |
| 130 | 46.497 | 2745.2 | 9.0203 | 37.194 | 2745.1 | 8.9171 | 30.992 | 2745.0 | 8.8328 | 130 |
| 135 | 47.075 | 2754.7 | 9.0438 | 37.656 | 2754.7 | 8.9406 | 31.377 | 2754.6 | 8.8563 | 135 |
| 140 | 47.653 | 2764.3 | 9.0670 | 38.119 | 2764.2 | 8.9639 | 31.763 | 2764.1 | 8.8796 | 140 |
| 145 | 48.230 | 2773.9 | 9.0900 | 38.581 | 2773.8 | 8.9869 | 32.148 | 2773.7 | 8.9026 | 145 |
| 150 | 48.808 | 2783.4 | 9.1128 | 39.043 | 2783.4 | 9.0097 | 32.533 | 2783.3 | 8.9254 | 150 |
| 155 | 49.385 | 2793.0 | 9.1353 | 39.505 | 2793.0 | 9.0322 | 32.918 | 2792.9 | 8.9480 | 155 |
| 160 | 49.963 | 2802.6 | 9.1576 | 39.967 | 2802.6 | 9.0545 | 33.304 | 2802.5 | 8.9703 | 160 |
| 165 | 50.540 | 2812.2 | 9.1797 | 40.429 | 2812.2 | 9.0766 | 33.689 | 2812.1 | 8.9923 | 165 |
| 170 | 51.118 | 2821.9 | 9.2015 | 40.891 | 2821.8 | 9.0984 | 34.074 | 2821.7 | 9.0142 | 170 |
| 175 | 51.695 | 2831.5 | 9.2231 | 41.353 | 2831.4 | 9.1201 | 34.459 | 2831.4 | 9.0358 | 175 |
| 180 | 52.272 | 2841.1 | 9.2445 | 41.815 | 2841.1 | 9.1415 | 34.844 | 2841.0 | 9.0572 | 180 |
| 185 | 52.850 | 2850.8 | 9.2657 | 42.277 | 2850.7 | 9.1627 | 35.229 | 2850.7 | 9.0784 | 185 |
| 190 | 53.427 | 2860.5 | 9.2867 | 42.739 | 2860.4 | 9.1837 | 35.614 | 2860.4 | 9.0995 | 190 |
| 195 | 54.004 | 2870.2 | 9.3075 | 43.201 | 2870.1 | 9.2045 | 35.999 | 2870.1 | 9.1203 | 195 |
| 200 | 54.582 | 2879.9 | 9.3282 | 43.663 | 2879.8 | 9.2251 | 36.384 | 2879.8 | 9.1409 | 200 |
| 205 | 55.159 | 2889.6 | 9.3486 | 44.125 | 2889.5 | 9.2455 | 36.769 | 2889.5 | 9.1613 | 205 |
| 210 | 55.736 | 2899.3 | 9.3688 | 44.587 | 2899.3 | 9.2658 | 37.154 | 2899.2 | 9.1816 | 210 |
| 215 | 56.313 | 2909.0 | 9.3889 | 45.049 | 2909.0 | 9.2858 | 37.539 | 2909.0 | 9.2016 | 215 |
| 220 | 56.891 | 2918.8 | 9.4088 | 45.511 | 2918.8 | 9.3057 | 37.924 | 2918.7 | 9.2215 | 220 |
| 225 | 57.468 | 2928.6 | 9.4285 | 45.972 | 2928.5 | 9.3254 | 38.309 | 2928.5 | 9.2412 | 225 |
| 230 | 58.045 | 2938.4 | 9.4480 | 46.434 | 2938.3 | 9.3450 | 38.694 | 2938.3 | 9.2608 | 230 |
| 235 | 58.622 | 2948.2 | 9.4674 | 46.896 | 2948.1 | 9.3644 | 39.078 | 2948.1 | 9.2802 | 235 |
| 240 | 59.199 | 2958.0 | 9.4866 | 47.358 | 2957.9 | 9.3836 | 39.463 | 2957.9 | 9.2994 | 240 |
| 245 | 59.776 | 2967.8 | 9.5057 | 47.819 | 2967.8 | 9.4026 | 39.848 | 2967.7 | 9.3185 | 245 |
| 250 | 60.354 | 2977.6 | 9.5246 | 48.281 | 2977.6 | 9.4216 | 40.233 | 2977.6 | 9.3374 | 250 |
| 255 | 60.931 | 2987.5 | 9.5433 | 48.743 | 2987.5 | 9.4403 | 40.618 | 2987.4 | 9.3561 | 255 |
| 260 | 61.508 | 2997.4 | 9.5619 | 49.205 | 2997.3 | 9.4589 | 41.003 | 2997.3 | 9.3747 | 260 |
| 265 | 62.085 | 3007.3 | 9.5804 | 49.666 | 3007.2 | 9.4774 | 41.387 | 3007.2 | 9.3932 | 265 |
| 270 | 62.662 | 3017.2 | 9.5987 | 50.128 | 3017.1 | 9.4957 | 41.772 | 3017.1 | 9.4115 | 270 |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.004 MPa ($t_{sat}$ = 28.96 °C) | | | 0.005 MPa ($t_{sat}$ = 32.88 °C) | | | 0.006 MPa ($t_{sat}$ = 36.16 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 63.239 | 3027.1 | 9.6169 | 50.590 | 3027.0 | 9.5139 | 42.157 | 3027.0 | 9.4297 | 275 |
| 280 | 63.816 | 3037.0 | 9.6349 | 51.052 | 3037.0 | 9.5319 | 42.542 | 3036.9 | 9.4477 | 280 |
| 285 | 64.393 | 3046.9 | 9.6528 | 51.513 | 3046.9 | 9.5498 | 42.927 | 3046.9 | 9.4656 | 285 |
| 290 | 64.970 | 3056.9 | 9.6706 | 51.975 | 3056.9 | 9.5676 | 43.311 | 3056.9 | 9.4834 | 290 |
| 295 | 65.547 | 3066.9 | 9.6882 | 52.437 | 3066.9 | 9.5852 | 43.696 | 3066.8 | 9.5010 | 295 |
| 300 | 66.125 | 3076.9 | 9.7057 | 52.898 | 3076.9 | 9.6027 | 44.081 | 3076.8 | 9.5185 | 300 |
| 310 | 67.279 | 3096.9 | 9.7404 | 53.822 | 3096.9 | 9.6374 | 44.850 | 3096.9 | 9.5532 | 310 |
| 320 | 68.433 | 3117.0 | 9.7745 | 54.745 | 3117.0 | 9.6715 | 45.620 | 3117.0 | 9.5874 | 320 |
| 330 | 69.587 | 3137.2 | 9.8082 | 55.668 | 3137.1 | 9.7052 | 46.389 | 3137.1 | 9.6211 | 330 |
| 340 | 70.741 | 3157.4 | 9.8415 | 56.592 | 3157.4 | 9.7385 | 47.159 | 3157.3 | 9.6543 | 340 |
| 350 | 71.895 | 3177.7 | 9.8743 | 57.515 | 3177.6 | 9.7713 | 47.928 | 3177.6 | 9.6871 | 350 |
| 360 | 73.049 | 3198.0 | 9.9067 | 58.438 | 3198.0 | 9.8037 | 48.698 | 3198.0 | 9.7195 | 360 |
| 370 | 74.203 | 3218.4 | 9.9387 | 59.361 | 3218.4 | 9.8357 | 49.467 | 3218.4 | 9.7515 | 370 |
| 380 | 75.357 | 3238.9 | 9.9703 | 60.285 | 3238.9 | 9.8673 | 50.237 | 3238.9 | 9.7831 | 380 |
| 390 | 76.511 | 3259.4 | 10.001 | 61.208 | 3259.4 | 9.8985 | 51.006 | 3259.4 | 9.8143 | 390 |
| 400 | 77.665 | 3280.0 | 10.032 | 62.131 | 3280.0 | 9.9293 | 51.775 | 3280.0 | 9.8451 | 400 |
| 410 | 78.819 | 3300.7 | 10.063 | 63.054 | 3300.7 | 9.9598 | 52.545 | 3300.7 | 9.8756 | 410 |
| 420 | 79.973 | 3321.4 | 10.093 | 63.978 | 3321.4 | 9.9899 | 53.314 | 3321.4 | 9.9058 | 420 |
| 430 | 81.127 | 3342.2 | 10.123 | 64.901 | 3342.2 | 10.020 | 54.083 | 3342.2 | 9.9356 | 430 |
| 440 | 82.281 | 3363.1 | 10.152 | 65.824 | 3363.1 | 10.049 | 54.853 | 3363.1 | 9.9650 | 440 |
| 450 | 83.435 | 3384.0 | 10.181 | 66.747 | 3384.0 | 10.078 | 55.622 | 3384.0 | 9.9942 | 450 |
| 460 | 84.589 | 3405.0 | 10.210 | 67.670 | 3405.0 | 10.107 | 56.391 | 3405.0 | 10.023 | 460 |
| 470 | 85.743 | 3426.1 | 10.239 | 68.594 | 3426.1 | 10.136 | 57.161 | 3426.1 | 10.052 | 470 |
| 480 | 86.897 | 3447.3 | 10.267 | 69.517 | 3447.2 | 10.164 | 57.930 | 3447.2 | 10.080 | 480 |
| 490 | 88.051 | 3468.5 | 10.295 | 70.440 | 3468.5 | 10.192 | 58.699 | 3468.4 | 10.108 | 490 |
| 500 | 89.205 | 3489.7 | 10.323 | 71.363 | 3489.7 | 10.220 | 59.469 | 3489.7 | 10.136 | 500 |
| 510 | 90.358 | 3511.1 | 10.350 | 72.286 | 3511.1 | 10.247 | 60.238 | 3511.1 | 10.163 | 510 |
| 520 | 91.512 | 3532.5 | 10.377 | 73.209 | 3532.5 | 10.274 | 61.007 | 3532.5 | 10.190 | 520 |
| 530 | 92.666 | 3554.0 | 10.404 | 74.133 | 3554.0 | 10.301 | 61.777 | 3554.0 | 10.217 | 530 |
| 540 | 93.820 | 3575.5 | 10.431 | 75.056 | 3575.5 | 10.328 | 62.546 | 3575.5 | 10.244 | 540 |
| 550 | 94.974 | 3597.2 | 10.457 | 75.979 | 3597.1 | 10.354 | 63.315 | 3597.1 | 10.270 | 550 |
| 560 | 96.128 | 3618.8 | 10.483 | 76.902 | 3618.8 | 10.380 | 64.085 | 3618.8 | 10.296 | 560 |
| 570 | 97.282 | 3640.6 | 10.509 | 77.825 | 3640.6 | 10.406 | 64.854 | 3640.6 | 10.322 | 570 |
| 580 | 98.436 | 3662.4 | 10.535 | 78.748 | 3662.4 | 10.432 | 65.623 | 3662.4 | 10.348 | 580 |
| 590 | 99.590 | 3684.3 | 10.561 | 79.671 | 3684.3 | 10.458 | 66.392 | 3684.3 | 10.374 | 590 |
| 600 | 100.74 | 3706.3 | 10.586 | 80.594 | 3706.3 | 10.483 | 67.162 | 3706.3 | 10.399 | 600 |
| 610 | 101.90 | 3728.4 | 10.611 | 81.518 | 3728.4 | 10.508 | 67.931 | 3728.3 | 10.424 | 610 |
| 620 | 103.05 | 3750.5 | 10.636 | 82.441 | 3750.5 | 10.533 | 68.700 | 3750.5 | 10.449 | 620 |
| 630 | 104.21 | 3772.7 | 10.661 | 83.364 | 3772.7 | 10.558 | 69.470 | 3772.6 | 10.474 | 630 |
| 640 | 105.36 | 3794.9 | 10.685 | 84.287 | 3794.9 | 10.582 | 70.239 | 3794.9 | 10.498 | 640 |
| 650 | 106.51 | 3817.2 | 10.710 | 85.210 | 3817.2 | 10.607 | 71.008 | 3817.2 | 10.522 | 650 |
| 660 | 107.67 | 3839.6 | 10.734 | 86.133 | 3839.6 | 10.631 | 71.777 | 3839.6 | 10.547 | 660 |
| 670 | 108.82 | 3862.1 | 10.758 | 87.056 | 3862.1 | 10.655 | 72.547 | 3862.1 | 10.570 | 670 |
| 680 | 109.97 | 3884.7 | 10.781 | 87.979 | 3884.6 | 10.678 | 73.316 | 3884.6 | 10.594 | 680 |
| 690 | 111.13 | 3907.3 | 10.805 | 88.902 | 3907.3 | 10.702 | 74.085 | 3907.2 | 10.618 | 690 |
| 700 | 112.28 | 3929.9 | 10.828 | 89.826 | 3929.9 | 10.725 | 74.854 | 3929.9 | 10.641 | 700 |
| 710 | 113.44 | 3952.7 | 10.852 | 90.749 | 3952.7 | 10.749 | 75.624 | 3952.7 | 10.665 | 710 |
| 720 | 114.59 | 3975.5 | 10.875 | 91.672 | 3975.5 | 10.772 | 76.393 | 3975.5 | 10.688 | 720 |
| 730 | 115.74 | 3998.4 | 10.898 | 92.595 | 3998.4 | 10.795 | 77.162 | 3998.4 | 10.711 | 730 |
| 740 | 116.90 | 4021.4 | 10.920 | 93.518 | 4021.4 | 10.817 | 77.931 | 4021.4 | 10.733 | 740 |
| 750 | 118.05 | 4044.4 | 10.943 | 94.441 | 4044.4 | 10.840 | 78.701 | 4044.4 | 10.756 | 750 |
| 760 | 119.21 | 4067.5 | 10.966 | 95.364 | 4067.5 | 10.863 | 79.470 | 4067.5 | 10.778 | 760 |
| 770 | 120.36 | 4090.7 | 10.988 | 96.287 | 4090.7 | 10.885 | 80.239 | 4090.7 | 10.801 | 770 |
| 780 | 121.51 | 4113.9 | 11.010 | 97.210 | 4113.9 | 10.907 | 81.008 | 4113.9 | 10.823 | 780 |
| 790 | 122.67 | 4137.3 | 11.032 | 98.133 | 4137.3 | 10.929 | 81.778 | 4137.2 | 10.845 | 790 |
| 800 | 123.82 | 4160.7 | 11.054 | 99.056 | 4160.7 | 10.951 | 82.547 | 4160.7 | 10.867 | 800 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.008 MPa ($t_{sat}$ = 41.51 °C) | | | 0.010 MPa ($t_{sat}$ = 45.81 °C) | | | 0.012 MPa ($t_{sat}$ = 49.42 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 008 5 | 173.85 | 0.5925 | 0.001 010 3 | 191.81 | 0.6492 | 0.001 011 9 | 206.91 | 0.6963 | Sat. Liq. |
| Sat. Vap. | 18.099 | 2576.2 | 8.2274 | 14.671 | 2583.9 | 8.1489 | 12.359 | 2590.3 | 8.0850 | Sat. Vap. |
| **0** | 0.001 000 2 | -0.03 | -0.0002 | 0.001 000 2 | -0.03 | -0.0002 | 0.001 000 2 | -0.03 | -0.0002 | **0** |
| **5** | 0.001 000 1 | 21.03 | 0.0763 | 0.001 000 1 | 21.03 | 0.0763 | 0.001 000 1 | 21.03 | 0.0763 | **5** |
| **10** | 0.001 000 3 | 42.03 | 0.1511 | 0.001 000 3 | 42.03 | 0.1511 | 0.001 000 3 | 42.03 | 0.1511 | **10** |
| **15** | 0.001 000 9 | 62.99 | 0.2245 | 0.001 000 9 | 62.99 | 0.2245 | 0.001 000 9 | 62.99 | 0.2245 | **15** |
| **20** | 0.001 001 8 | 83.93 | 0.2965 | 0.001 001 8 | 83.93 | 0.2965 | 0.001 001 8 | 83.93 | 0.2965 | **20** |
| **25** | 0.001 003 0 | 104.84 | 0.3673 | 0.001 003 0 | 104.84 | 0.3673 | 0.001 003 0 | 104.85 | 0.3673 | **25** |
| **30** | 0.001 004 4 | 125.75 | 0.4368 | 0.001 004 4 | 125.75 | 0.4368 | 0.001 004 4 | 125.75 | 0.4368 | **30** |
| **35** | 0.001 006 0 | 146.65 | 0.5052 | 0.001 006 0 | 146.65 | 0.5052 | 0.001 006 0 | 146.65 | 0.5052 | **35** |
| **40** | 0.001 007 9 | 167.54 | 0.5724 | 0.001 007 9 | 167.54 | 0.5724 | 0.001 007 9 | 167.55 | 0.5724 | **40** |
| **45** | 18.304 | 2583.0 | 8.2487 | 0.001 009 9 | 188.44 | 0.6386 | 0.001 009 9 | 188.44 | 0.6386 | **45** |
| **50** | 18.596 | 2592.6 | 8.2786 | 14.867 | 2592.0 | 8.1741 | 12.381 | 2591.4 | 8.0885 | **50** |
| **55** | 18.888 | 2602.1 | 8.3079 | 15.102 | 2601.6 | 8.2037 | 12.577 | 2601.1 | 8.1182 | **55** |
| **60** | 19.179 | 2611.6 | 8.3367 | 15.335 | 2611.2 | 8.2326 | 12.773 | 2610.7 | 8.1473 | **60** |
| **65** | 19.470 | 2621.1 | 8.3651 | 15.569 | 2620.7 | 8.2611 | 12.967 | 2620.3 | 8.1759 | **65** |
| **70** | 19.761 | 2630.6 | 8.3930 | 15.802 | 2630.3 | 8.2891 | 13.162 | 2629.9 | 8.2040 | **70** |
| **75** | 20.052 | 2640.2 | 8.4205 | 16.035 | 2639.8 | 8.3167 | 13.357 | 2639.5 | 8.2317 | **75** |
| **80** | 20.342 | 2649.7 | 8.4476 | 16.267 | 2649.3 | 8.3438 | 13.551 | 2649.0 | 8.2589 | **80** |
| **85** | 20.632 | 2659.2 | 8.4743 | 16.500 | 2658.9 | 8.3706 | 13.745 | 2658.6 | 8.2858 | **85** |
| **90** | 20.922 | 2668.7 | 8.5006 | 16.732 | 2668.4 | 8.3970 | 13.939 | 2668.1 | 8.3122 | **90** |
| **95** | 21.212 | 2678.2 | 8.5266 | 16.965 | 2677.9 | 8.4231 | 14.133 | 2677.6 | 8.3383 | **95** |
| **100** | 21.502 | 2687.7 | 8.5523 | 17.197 | 2687.4 | 8.4488 | 14.326 | 2687.2 | 8.3641 | **100** |
| **105** | 21.792 | 2697.2 | 8.5776 | 17.429 | 2697.0 | 8.4741 | 14.520 | 2696.7 | 8.3895 | **105** |
| **110** | 22.082 | 2706.7 | 8.6026 | 17.661 | 2706.5 | 8.4992 | 14.713 | 2706.3 | 8.4146 | **110** |
| **115** | 22.371 | 2716.2 | 8.6273 | 17.893 | 2716.0 | 8.5239 | 14.907 | 2715.8 | 8.4394 | **115** |
| **120** | 22.661 | 2725.8 | 8.6517 | 18.124 | 2725.6 | 8.5484 | 15.100 | 2725.4 | 8.4638 | **120** |
| **125** | 22.950 | 2735.3 | 8.6759 | 18.356 | 2735.1 | 8.5725 | 15.293 | 2735.0 | 8.4880 | **125** |
| **130** | 23.239 | 2744.9 | 8.6997 | 18.588 | 2744.7 | 8.5964 | 15.487 | 2744.5 | 8.5119 | **130** |
| **135** | 23.528 | 2754.4 | 8.7233 | 18.819 | 2754.3 | 8.6200 | 15.680 | 2754.1 | 8.5355 | **135** |
| **140** | 23.818 | 2764.0 | 8.7466 | 19.051 | 2763.8 | 8.6433 | 15.873 | 2763.7 | 8.5588 | **140** |
| **145** | 24.107 | 2773.6 | 8.7696 | 19.282 | 2773.4 | 8.6663 | 16.066 | 2773.3 | 8.5819 | **145** |
| **150** | 24.396 | 2783.2 | 8.7924 | 19.514 | 2783.0 | 8.6892 | 16.259 | 2782.9 | 8.6048 | **150** |
| **155** | 24.685 | 2792.8 | 8.8149 | 19.745 | 2792.6 | 8.7117 | 16.452 | 2792.5 | 8.6273 | **155** |
| **160** | 24.974 | 2802.4 | 8.8373 | 19.976 | 2802.2 | 8.7340 | 16.644 | 2802.1 | 8.6497 | **160** |
| **165** | 25.263 | 2812.0 | 8.8593 | 20.208 | 2811.9 | 8.7561 | 16.837 | 2811.7 | 8.6718 | **165** |
| **170** | 25.552 | 2821.6 | 8.8812 | 20.439 | 2821.5 | 8.7780 | 17.030 | 2821.4 | 8.6937 | **170** |
| **175** | 25.841 | 2831.3 | 8.9029 | 20.670 | 2831.2 | 8.7997 | 17.223 | 2831.0 | 8.7153 | **175** |
| **180** | 26.130 | 2840.9 | 8.9243 | 20.901 | 2840.8 | 8.8211 | 17.416 | 2840.7 | 8.7368 | **180** |
| **185** | 26.419 | 2850.6 | 8.9455 | 21.133 | 2850.5 | 8.8423 | 17.608 | 2850.4 | 8.7580 | **185** |
| **190** | 26.708 | 2860.3 | 8.9665 | 21.364 | 2860.2 | 8.8634 | 17.801 | 2860.1 | 8.7791 | **190** |
| **195** | 26.996 | 2870.0 | 8.9873 | 21.595 | 2869.9 | 8.8842 | 17.994 | 2869.8 | 8.7999 | **195** |
| **200** | 27.285 | 2879.7 | 9.0080 | 21.826 | 2879.6 | 8.9048 | 18.186 | 2879.5 | 8.8205 | **200** |
| **205** | 27.574 | 2889.4 | 9.0284 | 22.057 | 2889.3 | 8.9253 | 18.379 | 2889.2 | 8.8410 | **205** |
| **210** | 27.863 | 2899.1 | 9.0487 | 22.288 | 2899.1 | 8.9455 | 18.572 | 2899.0 | 8.8613 | **210** |
| **215** | 28.152 | 2908.9 | 9.0687 | 22.519 | 2908.8 | 8.9656 | 18.764 | 2908.7 | 8.8813 | **215** |
| **220** | 28.440 | 2918.6 | 9.0886 | 22.750 | 2918.6 | 8.9855 | 18.957 | 2918.5 | 8.9013 | **220** |
| **225** | 28.729 | 2928.4 | 9.1083 | 22.981 | 2928.3 | 9.0052 | 19.150 | 2928.3 | 8.9210 | **225** |
| **230** | 29.018 | 2938.2 | 9.1279 | 23.212 | 2938.1 | 9.0248 | 19.342 | 2938.1 | 8.9406 | **230** |
| **235** | 29.307 | 2948.0 | 9.1473 | 23.443 | 2947.9 | 9.0442 | 19.535 | 2947.9 | 8.9600 | **235** |
| **240** | 29.595 | 2957.8 | 9.1665 | 23.674 | 2957.8 | 9.0634 | 19.727 | 2957.7 | 8.9792 | **240** |
| **245** | 29.884 | 2967.7 | 9.1856 | 23.905 | 2967.6 | 9.0825 | 19.920 | 2967.5 | 8.9983 | **245** |
| **250** | 30.173 | 2977.5 | 9.2045 | 24.136 | 2977.4 | 9.1014 | 20.112 | 2977.4 | 9.0172 | **250** |
| **255** | 30.461 | 2987.4 | 9.2233 | 24.367 | 2987.3 | 9.1202 | 20.305 | 2987.2 | 9.0359 | **255** |
| **260** | 30.750 | 2997.2 | 9.2419 | 24.598 | 2997.2 | 9.1388 | 20.497 | 2997.1 | 9.0546 | **260** |
| **265** | 31.039 | 3007.1 | 9.2603 | 24.829 | 3007.1 | 9.1573 | 20.690 | 3007.0 | 9.0730 | **265** |
| **270** | 31.327 | 3017.0 | 9.2786 | 25.060 | 3017.0 | 9.1756 | 20.882 | 3016.9 | 9.0914 | **270** |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.008 MPa ($t_{sat}$ = 41.51 °C) | | | 0.010 MPa ($t_{sat}$ = 45.81 °C) | | | 0.012 MPa ($t_{sat}$ = 49.42 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 31.616 | 3027.0 | 9.2968 | 25.291 | 3026.9 | 9.1938 | 21.075 | 3026.8 | 9.1095 | 275 |
| 280 | 31.905 | 3036.9 | 9.3149 | 25.522 | 3036.8 | 9.2118 | 21.267 | 3036.8 | 9.1276 | 280 |
| 285 | 32.193 | 3046.8 | 9.3328 | 25.753 | 3046.8 | 9.2297 | 21.460 | 3046.7 | 9.1455 | 285 |
| 290 | 32.482 | 3056.8 | 9.3505 | 25.984 | 3056.8 | 9.2475 | 21.652 | 3056.7 | 9.1633 | 290 |
| 295 | 32.770 | 3066.8 | 9.3682 | 26.215 | 3066.7 | 9.2651 | 21.845 | 3066.7 | 9.1809 | 295 |
| 300 | 33.059 | 3076.8 | 9.3857 | 26.446 | 3076.7 | 9.2827 | 22.037 | 3076.7 | 9.1984 | 300 |
| 310 | 33.636 | 3096.8 | 9.4204 | 26.908 | 3096.8 | 9.3173 | 22.422 | 3096.7 | 9.2331 | 310 |
| 320 | 34.214 | 3116.9 | 9.4545 | 27.370 | 3116.9 | 9.3515 | 22.807 | 3116.8 | 9.2673 | 320 |
| 330 | 34.791 | 3137.1 | 9.4882 | 27.831 | 3137.0 | 9.3852 | 23.192 | 3137.0 | 9.3010 | 330 |
| 340 | 35.368 | 3157.3 | 9.5215 | 28.293 | 3157.3 | 9.4185 | 23.577 | 3157.2 | 9.3343 | 340 |
| 350 | 35.945 | 3177.6 | 9.5543 | 28.755 | 3177.5 | 9.4513 | 23.962 | 3177.5 | 9.3671 | 350 |
| 360 | 36.522 | 3197.9 | 9.5867 | 29.217 | 3197.9 | 9.4837 | 24.346 | 3197.9 | 9.3995 | 360 |
| 370 | 37.099 | 3218.3 | 9.6187 | 29.678 | 3218.3 | 9.5157 | 24.731 | 3218.3 | 9.4315 | 370 |
| 380 | 37.676 | 3238.8 | 9.6503 | 30.140 | 3238.8 | 9.5473 | 25.116 | 3238.8 | 9.4631 | 380 |
| 390 | 38.253 | 3259.4 | 9.6815 | 30.602 | 3259.3 | 9.5785 | 25.501 | 3259.3 | 9.4943 | 390 |
| 400 | 38.830 | 3280.0 | 9.7123 | 31.064 | 3279.9 | 9.6093 | 25.886 | 3279.9 | 9.5251 | 400 |
| 410 | 39.408 | 3300.6 | 9.7428 | 31.525 | 3300.6 | 9.6398 | 26.270 | 3300.6 | 9.5556 | 410 |
| 420 | 39.985 | 3321.4 | 9.7730 | 31.987 | 3321.3 | 9.6699 | 26.655 | 3321.3 | 9.5858 | 420 |
| 430 | 40.562 | 3342.2 | 9.8028 | 32.449 | 3342.2 | 9.6997 | 27.040 | 3342.1 | 9.6156 | 430 |
| 440 | 41.139 | 3363.1 | 9.8322 | 32.910 | 3363.0 | 9.7292 | 27.425 | 3363.0 | 9.6450 | 440 |
| 450 | 41.716 | 3384.0 | 9.8614 | 33.372 | 3384.0 | 9.7584 | 27.809 | 3383.9 | 9.6742 | 450 |
| 460 | 42.293 | 3405.0 | 9.8902 | 33.834 | 3405.0 | 9.7872 | 28.194 | 3404.9 | 9.7030 | 460 |
| 470 | 42.870 | 3426.1 | 9.9188 | 34.295 | 3426.0 | 9.8158 | 28.579 | 3426.0 | 9.7316 | 470 |
| 480 | 43.447 | 3447.2 | 9.9470 | 34.757 | 3447.2 | 9.8440 | 28.964 | 3447.2 | 9.7599 | 480 |
| 490 | 44.024 | 3468.4 | 9.9750 | 35.219 | 3468.4 | 9.8720 | 29.348 | 3468.4 | 9.7878 | 490 |
| 500 | 44.601 | 3489.7 | 10.003 | 35.680 | 3489.7 | 9.8997 | 29.733 | 3489.7 | 9.8155 | 500 |
| 510 | 45.178 | 3511.0 | 10.030 | 36.142 | 3511.0 | 9.9271 | 30.118 | 3511.0 | 9.8430 | 510 |
| 520 | 45.755 | 3532.5 | 10.057 | 36.603 | 3532.4 | 9.9543 | 30.502 | 3532.4 | 9.8701 | 520 |
| 530 | 46.332 | 3553.9 | 10.084 | 37.065 | 3553.9 | 9.9812 | 30.887 | 3553.9 | 9.8971 | 530 |
| 540 | 46.909 | 3575.5 | 10.111 | 37.527 | 3575.5 | 10.008 | 31.272 | 3575.5 | 9.9237 | 540 |
| 550 | 47.486 | 3597.1 | 10.137 | 37.988 | 3597.1 | 10.034 | 31.657 | 3597.1 | 9.9502 | 550 |
| 560 | 48.063 | 3618.8 | 10.164 | 38.450 | 3618.8 | 10.061 | 32.041 | 3618.8 | 9.9764 | 560 |
| 570 | 48.640 | 3640.6 | 10.189 | 38.911 | 3640.6 | 10.086 | 32.426 | 3640.5 | 10.002 | 570 |
| 580 | 49.217 | 3662.4 | 10.215 | 39.373 | 3662.4 | 10.112 | 32.811 | 3662.4 | 10.028 | 580 |
| 590 | 49.794 | 3684.3 | 10.241 | 39.835 | 3684.3 | 10.138 | 33.195 | 3684.3 | 10.054 | 590 |
| 600 | 50.371 | 3706.3 | 10.266 | 40.296 | 3706.3 | 10.163 | 33.580 | 3706.3 | 10.079 | 600 |
| 610 | 50.948 | 3728.3 | 10.291 | 40.758 | 3728.3 | 10.188 | 33.965 | 3728.3 | 10.104 | 610 |
| 620 | 51.525 | 3750.4 | 10.316 | 41.219 | 3750.4 | 10.213 | 34.349 | 3750.4 | 10.129 | 620 |
| 630 | 52.102 | 3772.6 | 10.341 | 41.681 | 3772.6 | 10.238 | 34.734 | 3772.6 | 10.154 | 630 |
| 640 | 52.679 | 3794.9 | 10.365 | 42.143 | 3794.9 | 10.262 | 35.119 | 3794.9 | 10.178 | 640 |
| 650 | 53.256 | 3817.2 | 10.390 | 42.604 | 3817.2 | 10.287 | 35.503 | 3817.2 | 10.202 | 650 |
| 660 | 53.833 | 3839.6 | 10.414 | 43.066 | 3839.6 | 10.311 | 35.888 | 3839.6 | 10.227 | 660 |
| 670 | 54.410 | 3862.1 | 10.438 | 43.527 | 3862.1 | 10.335 | 36.273 | 3862.1 | 10.251 | 670 |
| 680 | 54.987 | 3884.6 | 10.461 | 43.989 | 3884.6 | 10.358 | 36.657 | 3884.6 | 10.274 | 680 |
| 690 | 55.563 | 3907.2 | 10.485 | 44.451 | 3907.2 | 10.382 | 37.042 | 3907.2 | 10.298 | 690 |
| 700 | 56.140 | 3929.9 | 10.508 | 44.912 | 3929.9 | 10.405 | 37.427 | 3929.9 | 10.321 | 700 |
| 710 | 56.717 | 3952.7 | 10.532 | 45.374 | 3952.7 | 10.429 | 37.811 | 3952.6 | 10.345 | 710 |
| 720 | 57.294 | 3975.5 | 10.555 | 45.835 | 3975.5 | 10.452 | 38.196 | 3975.5 | 10.368 | 720 |
| 730 | 57.871 | 3998.4 | 10.578 | 46.297 | 3998.4 | 10.475 | 38.580 | 3998.4 | 10.391 | 730 |
| 740 | 58.448 | 4021.4 | 10.601 | 46.758 | 4021.3 | 10.498 | 38.965 | 4021.3 | 10.413 | 740 |
| 750 | 59.025 | 4044.4 | 10.623 | 47.220 | 4044.4 | 10.520 | 39.350 | 4044.4 | 10.436 | 750 |
| 760 | 59.602 | 4067.5 | 10.646 | 47.682 | 4067.5 | 10.543 | 39.734 | 4067.5 | 10.459 | 760 |
| 770 | 60.179 | 4090.7 | 10.668 | 48.143 | 4090.7 | 10.565 | 40.119 | 4090.7 | 10.481 | 770 |
| 780 | 60.756 | 4113.9 | 10.690 | 48.605 | 4113.9 | 10.587 | 40.504 | 4113.9 | 10.503 | 780 |
| 790 | 61.333 | 4137.2 | 10.712 | 49.066 | 4137.2 | 10.609 | 40.888 | 4137.2 | 10.525 | 790 |
| 800 | 61.910 | 4160.6 | 10.734 | 49.528 | 4160.6 | 10.631 | 41.273 | 4160.6 | 10.547 | 800 |

**UNITS**: $v$ in $m^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.014 MPa ($t_{sat}$ = 52.55 °C) | | | 0.016 MPa ($t_{sat}$ = 55.31 °C) | | | 0.018 MPa ($t_{sat}$ = 57.80 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 013 3 | 219.99 | 0.7366 | 0.001 014 7 | 231.55 | 0.7720 | 0.001 016 0 | 241.95 | 0.8035 | Sat. Liq |
| Sat. Vap. | 10.691 | 2595.8 | 8.0312 | 9.4309 | 2600.7 | 7.9847 | 8.4433 | 2605.0 | 7.9437 | Sat. Vap |
| 0 | 0.001 000 2 | -0.03 | -0.0002 | 0.001 000 2 | -0.03 | -0.0002 | 0.001 000 2 | -0.02 | -0.0002 | 0 |
| 5 | 0.001 000 1 | 21.03 | 0.0763 | 0.001 000 1 | 21.03 | 0.0763 | 0.001 000 1 | 21.04 | 0.0763 | 5 |
| 10 | 0.001 000 3 | 42.03 | 0.1511 | 0.001 000 3 | 42.04 | 0.1511 | 0.001 000 3 | 42.04 | 0.1511 | 10 |
| 15 | 0.001 000 9 | 63.00 | 0.2245 | 0.001 000 9 | 63.00 | 0.2245 | 0.001 000 9 | 63.00 | 0.2245 | 15 |
| 20 | 0.001 001 8 | 83.93 | 0.2965 | 0.001 001 8 | 83.93 | 0.2965 | 0.001 001 8 | 83.93 | 0.2965 | 20 |
| 25 | 0.001 003 0 | 104.85 | 0.3673 | 0.001 003 0 | 104.85 | 0.3673 | 0.001 003 0 | 104.85 | 0.3673 | 25 |
| 30 | 0.001 004 4 | 125.75 | 0.4368 | 0.001 004 4 | 125.76 | 0.4368 | 0.001 004 4 | 125.76 | 0.4368 | 30 |
| 35 | 0.001 006 0 | 146.65 | 0.5052 | 0.001 006 0 | 146.65 | 0.5052 | 0.001 006 0 | 146.66 | 0.5052 | 35 |
| 40 | 0.001 007 9 | 167.55 | 0.5724 | 0.001 007 9 | 167.55 | 0.5724 | 0.001 007 9 | 167.55 | 0.5724 | 40 |
| 45 | 0.001 009 9 | 188.44 | 0.6386 | 0.001 009 9 | 188.44 | 0.6386 | 0.001 009 9 | 188.44 | 0.6386 | 45 |
| 50 | 0.001 012 1 | 209.34 | 0.7038 | 0.001 012 1 | 209.34 | 0.7038 | 0.001 012 1 | 209.34 | 0.7038 | 50 |
| 55 | 10.774 | 2600.6 | 8.0458 | 0.001 014 5 | 230.24 | 0.7680 | 0.001 014 5 | 230.24 | 0.7680 | 55 |
| 60 | 10.942 | 2610.3 | 8.0751 | 9.5690 | 2609.8 | 8.0123 | 8.5011 | 2609.3 | 7.9567 | 60 |
| 65 | 11.110 | 2619.9 | 8.1038 | 9.7160 | 2619.5 | 8.0411 | 8.6321 | 2619.1 | 7.9857 | 65 |
| 70 | 11.277 | 2629.5 | 8.1320 | 9.8626 | 2629.1 | 8.0694 | 8.7628 | 2628.7 | 8.0142 | 70 |
| 75 | 11.444 | 2639.1 | 8.1597 | 10.009 | 2638.7 | 8.0973 | 8.8931 | 2638.4 | 8.0421 | 75 |
| 80 | 11.611 | 2648.7 | 8.1870 | 10.155 | 2648.3 | 8.1247 | 9.0233 | 2648.0 | 8.0696 | 80 |
| 85 | 11.777 | 2658.2 | 8.2140 | 10.301 | 2657.9 | 8.1516 | 9.1533 | 2657.6 | 8.0966 | 85 |
| 90 | 11.944 | 2667.8 | 8.2405 | 10.447 | 2667.5 | 8.1782 | 9.2832 | 2667.2 | 8.1232 | 90 |
| 95 | 12.110 | 2677.4 | 8.2666 | 10.593 | 2677.1 | 8.2044 | 9.4129 | 2676.8 | 8.1495 | 95 |
| 100 | 12.276 | 2686.9 | 8.2924 | 10.738 | 2686.7 | 8.2303 | 9.5425 | 2686.4 | 8.1754 | 100 |
| 105 | 12.442 | 2696.5 | 8.3179 | 10.884 | 2696.3 | 8.2558 | 9.6720 | 2696.0 | 8.2009 | 105 |
| 110 | 12.608 | 2706.1 | 8.3430 | 11.029 | 2705.8 | 8.2809 | 9.8013 | 2705.6 | 8.2261 | 110 |
| 115 | 12.774 | 2715.6 | 8.3678 | 11.175 | 2715.4 | 8.3058 | 9.9306 | 2715.2 | 8.2510 | 115 |
| 120 | 12.940 | 2725.2 | 8.3923 | 11.320 | 2725.0 | 8.3303 | 10.060 | 2724.8 | 8.2755 | 120 |
| 125 | 13.106 | 2734.8 | 8.4165 | 11.465 | 2734.6 | 8.3545 | 10.189 | 2734.4 | 8.2998 | 125 |
| 130 | 13.271 | 2744.3 | 8.4404 | 11.610 | 2744.2 | 8.3784 | 10.318 | 2744.0 | 8.3238 | 130 |
| 135 | 13.437 | 2753.9 | 8.4640 | 11.755 | 2753.8 | 8.4021 | 10.447 | 2753.6 | 8.3474 | 135 |
| 140 | 13.603 | 2763.5 | 8.4874 | 11.900 | 2763.4 | 8.4255 | 10.576 | 2763.2 | 8.3708 | 140 |
| 145 | 13.768 | 2773.1 | 8.5105 | 12.045 | 2773.0 | 8.4486 | 10.705 | 2772.8 | 8.3940 | 145 |
| 150 | 13.934 | 2782.7 | 8.5334 | 12.190 | 2782.6 | 8.4715 | 10.834 | 2782.5 | 8.4169 | 150 |
| 155 | 14.099 | 2792.4 | 8.5560 | 12.335 | 2792.2 | 8.4941 | 10.963 | 2792.1 | 8.4395 | 155 |
| 160 | 14.265 | 2802.0 | 8.5783 | 12.480 | 2801.9 | 8.5165 | 11.091 | 2801.7 | 8.4619 | 160 |
| 165 | 14.430 | 2811.6 | 8.6004 | 12.624 | 2811.5 | 8.5386 | 11.220 | 2811.4 | 8.4840 | 165 |
| 170 | 14.595 | 2821.3 | 8.6223 | 12.769 | 2821.2 | 8.5605 | 11.349 | 2821.0 | 8.5059 | 170 |
| 175 | 14.761 | 2830.9 | 8.6440 | 12.914 | 2830.8 | 8.5822 | 11.478 | 2830.7 | 8.5276 | 175 |
| 180 | 14.926 | 2840.6 | 8.6655 | 13.059 | 2840.5 | 8.6037 | 11.606 | 2840.4 | 8.5491 | 180 |
| 185 | 15.091 | 2850.3 | 8.6867 | 13.203 | 2850.2 | 8.6249 | 11.735 | 2850.1 | 8.5704 | 185 |
| 190 | 15.256 | 2860.0 | 8.7078 | 13.348 | 2859.9 | 8.6460 | 11.863 | 2859.8 | 8.5915 | 190 |
| 195 | 15.422 | 2869.7 | 8.7286 | 13.492 | 2869.6 | 8.6668 | 11.992 | 2869.5 | 8.6123 | 195 |
| 200 | 15.587 | 2879.4 | 8.7493 | 13.637 | 2879.3 | 8.6875 | 12.121 | 2879.2 | 8.6330 | 200 |
| 205 | 15.752 | 2889.1 | 8.7697 | 13.782 | 2889.1 | 8.7080 | 12.249 | 2889.0 | 8.6535 | 205 |
| 210 | 15.917 | 2898.9 | 8.7900 | 13.926 | 2898.8 | 8.7282 | 12.378 | 2898.7 | 8.6737 | 210 |
| 215 | 16.082 | 2908.6 | 8.8101 | 14.071 | 2908.6 | 8.7483 | 12.506 | 2908.5 | 8.6938 | 215 |
| 220 | 16.247 | 2918.4 | 8.8300 | 14.215 | 2918.3 | 8.7682 | 12.635 | 2918.3 | 8.7138 | 220 |
| 225 | 16.413 | 2928.2 | 8.8497 | 14.360 | 2928.1 | 8.7880 | 12.763 | 2928.0 | 8.7335 | 225 |
| 230 | 16.578 | 2938.0 | 8.8693 | 14.504 | 2937.9 | 8.8076 | 12.892 | 2937.8 | 8.7531 | 230 |
| 235 | 16.743 | 2947.8 | 8.8887 | 14.649 | 2947.7 | 8.8270 | 13.020 | 2947.7 | 8.7725 | 235 |
| 240 | 16.908 | 2957.6 | 8.9079 | 14.793 | 2957.6 | 8.8462 | 13.149 | 2957.5 | 8.7918 | 240 |
| 245 | 17.073 | 2967.5 | 8.9270 | 14.938 | 2967.4 | 8.8653 | 13.277 | 2967.3 | 8.8108 | 245 |
| 250 | 17.238 | 2977.3 | 8.9459 | 15.082 | 2977.3 | 8.8842 | 13.405 | 2977.2 | 8.8298 | 250 |
| 255 | 17.403 | 2987.2 | 8.9647 | 15.227 | 2987.1 | 8.9030 | 13.534 | 2987.1 | 8.8486 | 255 |
| 260 | 17.568 | 2997.1 | 8.9833 | 15.371 | 2997.0 | 8.9216 | 13.662 | 2996.9 | 8.8672 | 260 |
| 265 | 17.733 | 3007.0 | 9.0018 | 15.516 | 3006.9 | 8.9401 | 13.791 | 3006.8 | 8.8857 | 265 |
| 270 | 17.898 | 3016.9 | 9.0201 | 15.660 | 3016.8 | 8.9584 | 13.919 | 3016.8 | 8.9040 | 270 |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.014 MPa ($t_{sat}$ = 52.55 °C) | | | 0.016 MPa ($t_{sat}$ = 55.31 °C) | | | 0.018 MPa ($t_{sat}$ = 57.80 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 18.063 | 3026.8 | 9.0383 | 15.804 | 3026.7 | 8.9766 | 14.048 | 3026.7 | 8.9222 | 275 |
| 280 | 18.228 | 3036.7 | 9.0564 | 15.949 | 3036.7 | 8.9947 | 14.176 | 3036.6 | 8.9402 | 280 |
| 285 | 18.393 | 3046.7 | 9.0743 | 16.093 | 3046.6 | 9.0126 | 14.304 | 3046.6 | 8.9582 | 285 |
| 290 | 18.558 | 3056.7 | 9.0921 | 16.238 | 3056.6 | 9.0304 | 14.433 | 3056.6 | 8.9759 | 290 |
| 295 | 18.723 | 3066.6 | 9.1097 | 16.382 | 3066.6 | 9.0480 | 14.561 | 3066.5 | 8.9936 | 295 |
| 300 | 18.888 | 3076.6 | 9.1272 | 16.526 | 3076.6 | 9.0655 | 14.689 | 3076.5 | 9.0111 | 300 |
| 310 | 19.218 | 3096.7 | 9.1619 | 16.815 | 3096.6 | 9.1002 | 14.946 | 3096.6 | 9.0458 | 310 |
| 320 | 19.548 | 3116.8 | 9.1961 | 17.104 | 3116.7 | 9.1344 | 15.203 | 3116.7 | 9.0800 | 320 |
| 330 | 19.878 | 3136.9 | 9.2298 | 17.393 | 3136.9 | 9.1681 | 15.459 | 3136.9 | 9.1137 | 330 |
| 340 | 20.208 | 3157.2 | 9.2631 | 17.681 | 3157.1 | 9.2014 | 15.716 | 3157.1 | 9.1470 | 340 |
| 350 | 20.538 | 3177.5 | 9.2959 | 17.970 | 3177.4 | 9.2342 | 15.973 | 3177.4 | 9.1798 | 350 |
| 360 | 20.868 | 3197.8 | 9.3283 | 18.259 | 3197.8 | 9.2666 | 16.229 | 3197.7 | 9.2122 | 360 |
| 370 | 21.198 | 3218.2 | 9.3603 | 18.547 | 3218.2 | 9.2986 | 16.486 | 3218.2 | 9.2442 | 370 |
| 380 | 21.527 | 3238.7 | 9.3919 | 18.836 | 3238.7 | 9.3302 | 16.743 | 3238.7 | 9.2758 | 380 |
| 390 | 21.857 | 3259.3 | 9.4231 | 19.125 | 3259.2 | 9.3614 | 16.999 | 3259.2 | 9.3070 | 390 |
| 400 | 22.187 | 3279.9 | 9.4540 | 19.413 | 3279.8 | 9.3923 | 17.256 | 3279.8 | 9.3379 | 400 |
| 410 | 22.517 | 3300.5 | 9.4844 | 19.702 | 3300.5 | 9.4228 | 17.512 | 3300.5 | 9.3684 | 410 |
| 420 | 22.847 | 3321.3 | 9.5146 | 19.990 | 3321.3 | 9.4529 | 17.769 | 3321.2 | 9.3985 | 420 |
| 430 | 23.177 | 3342.1 | 9.5444 | 20.279 | 3342.1 | 9.4827 | 18.025 | 3342.0 | 9.4283 | 430 |
| 440 | 23.506 | 3363.0 | 9.5739 | 20.568 | 3362.9 | 9.5122 | 18.282 | 3362.9 | 9.4578 | 440 |
| 450 | 23.836 | 3383.9 | 9.6030 | 20.856 | 3383.9 | 9.5414 | 18.539 | 3383.9 | 9.4870 | 450 |
| 460 | 24.166 | 3404.9 | 9.6319 | 21.145 | 3404.9 | 9.5702 | 18.795 | 3404.9 | 9.5158 | 460 |
| 470 | 24.496 | 3426.0 | 9.6604 | 21.433 | 3426.0 | 9.5988 | 19.052 | 3425.9 | 9.5444 | 470 |
| 480 | 24.826 | 3447.1 | 9.6887 | 21.722 | 3447.1 | 9.6270 | 19.308 | 3447.1 | 9.5727 | 480 |
| 490 | 25.155 | 3468.4 | 9.7167 | 22.011 | 3468.3 | 9.6550 | 19.565 | 3468.3 | 9.6006 | 490 |
| 500 | 25.485 | 3489.6 | 9.7444 | 22.299 | 3489.6 | 9.6827 | 19.821 | 3489.6 | 9.6283 | 500 |
| 510 | 25.815 | 3511.0 | 9.7718 | 22.588 | 3511.0 | 9.7102 | 20.078 | 3510.9 | 9.6558 | 510 |
| 520 | 26.145 | 3532.4 | 9.7990 | 22.876 | 3532.4 | 9.7373 | 20.334 | 3532.4 | 9.6830 | 520 |
| 530 | 26.474 | 3553.9 | 9.8259 | 23.165 | 3553.9 | 9.7643 | 20.591 | 3553.8 | 9.7099 | 530 |
| 540 | 26.804 | 3575.4 | 9.8526 | 23.453 | 3575.4 | 9.7909 | 20.847 | 3575.4 | 9.7365 | 540 |
| 550 | 27.134 | 3597.1 | 9.8790 | 23.742 | 3597.0 | 9.8174 | 21.104 | 3597.0 | 9.7630 | 550 |
| 560 | 27.464 | 3618.8 | 9.9052 | 24.030 | 3618.7 | 9.8436 | 21.360 | 3618.7 | 9.7892 | 560 |
| 570 | 27.793 | 3640.5 | 9.9312 | 24.319 | 3640.5 | 9.8695 | 21.617 | 3640.5 | 9.8151 | 570 |
| 580 | 28.123 | 3662.4 | 9.9569 | 24.607 | 3662.3 | 9.8953 | 21.873 | 3662.3 | 9.8409 | 580 |
| 590 | 28.453 | 3684.3 | 9.9824 | 24.896 | 3684.2 | 9.9208 | 22.130 | 3684.2 | 9.8664 | 590 |
| 600 | 28.783 | 3706.2 | 10.008 | 25.184 | 3706.2 | 9.9461 | 22.386 | 3706.2 | 9.8917 | 600 |
| 610 | 29.112 | 3728.3 | 10.033 | 25.473 | 3728.3 | 9.9712 | 22.642 | 3728.3 | 9.9168 | 610 |
| 620 | 29.442 | 3750.4 | 10.058 | 25.762 | 3750.4 | 9.9961 | 22.899 | 3750.4 | 9.9417 | 620 |
| 630 | 29.772 | 3772.6 | 10.082 | 26.050 | 3772.6 | 10.021 | 23.155 | 3772.6 | 9.9665 | 630 |
| 640 | 30.101 | 3794.8 | 10.107 | 26.339 | 3794.8 | 10.045 | 23.412 | 3794.8 | 9.9910 | 640 |
| 650 | 30.431 | 3817.2 | 10.131 | 26.627 | 3817.2 | 10.070 | 23.668 | 3817.2 | 10.015 | 650 |
| 660 | 30.761 | 3839.6 | 10.155 | 26.916 | 3839.6 | 10.094 | 23.925 | 3839.6 | 10.039 | 660 |
| 670 | 31.091 | 3862.0 | 10.179 | 27.204 | 3862.0 | 10.118 | 24.181 | 3862.0 | 10.063 | 670 |
| 680 | 31.420 | 3884.6 | 10.203 | 27.493 | 3884.6 | 10.142 | 24.438 | 3884.6 | 10.087 | 680 |
| 690 | 31.750 | 3907.2 | 10.227 | 27.781 | 3907.2 | 10.165 | 24.694 | 3907.2 | 10.111 | 690 |
| 700 | 32.080 | 3929.9 | 10.250 | 28.070 | 3929.9 | 10.189 | 24.951 | 3929.9 | 10.134 | 700 |
| 710 | 32.409 | 3952.6 | 10.273 | 28.358 | 3952.6 | 10.212 | 25.207 | 3952.6 | 10.157 | 710 |
| 720 | 32.739 | 3975.5 | 10.297 | 28.647 | 3975.5 | 10.235 | 25.463 | 3975.4 | 10.181 | 720 |
| 730 | 33.069 | 3998.4 | 10.319 | 28.935 | 3998.3 | 10.258 | 25.720 | 3998.3 | 10.203 | 730 |
| 740 | 33.399 | 4021.3 | 10.342 | 29.224 | 4021.3 | 10.281 | 25.976 | 4021.3 | 10.226 | 740 |
| 750 | 33.728 | 4044.4 | 10.365 | 29.512 | 4044.3 | 10.303 | 26.233 | 4044.3 | 10.249 | 750 |
| 760 | 34.058 | 4067.5 | 10.387 | 29.801 | 4067.5 | 10.326 | 26.489 | 4067.4 | 10.271 | 760 |
| 770 | 34.388 | 4090.6 | 10.410 | 30.089 | 4090.6 | 10.348 | 26.746 | 4090.6 | 10.294 | 770 |
| 780 | 34.717 | 4113.9 | 10.432 | 30.378 | 4113.9 | 10.370 | 27.002 | 4113.9 | 10.316 | 780 |
| 790 | 35.047 | 4137.2 | 10.454 | 30.666 | 4137.2 | 10.392 | 27.259 | 4137.2 | 10.338 | 790 |
| 800 | 35.377 | 4160.6 | 10.476 | 30.955 | 4160.6 | 10.414 | 27.515 | 4160.6 | 10.360 | 800 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.020 MPa ($t_{sat}$ = 60.06 °C) | | | 0.025 MPa ($t_{sat}$ = 64.96 °C) | | | 0.030 MPa ($t_{sat}$ = 69.10 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 017 1 | 251.40 | 0.8320 | 0.001 019 8 | 271.93 | 0.8931 | 0.001 022 2 | 289.23 | 0.9439 | Sat. Liq. |
| Sat. Vap. | 7.6482 | 2608.9 | 7.9072 | 6.2034 | 2617.4 | 7.8302 | 5.2286 | 2624.6 | 7.7675 | Sat. Vap |
| 0 | 0.001 000 2 | -0.02 | -0.0002 | 0.001 000 2 | -0.02 | -0.0002 | 0.001 000 2 | -0.01 | -0.0002 | 0 |
| 5 | 0.001 000 1 | 21.04 | 0.0763 | 0.001 000 1 | 21.04 | 0.0763 | 0.001 000 1 | 21.05 | 0.0763 | 5 |
| 10 | 0.001 000 3 | 42.04 | 0.1511 | 0.001 000 3 | 42.04 | 0.1511 | 0.001 000 3 | 42.05 | 0.1511 | 10 |
| 15 | 0.001 000 9 | 63.00 | 0.2245 | 0.001 000 9 | 63.01 | 0.2245 | 0.001 000 9 | 63.01 | 0.2245 | 15 |
| 20 | 0.001 001 8 | 83.94 | 0.2965 | 0.001 001 8 | 83.94 | 0.2965 | 0.001 001 8 | 83.95 | 0.2965 | 20 |
| 25 | 0.001 003 0 | 104.85 | 0.3673 | 0.001 003 0 | 104.86 | 0.3673 | 0.001 003 0 | 104.86 | 0.3672 | 25 |
| 30 | 0.001 004 4 | 125.76 | 0.4368 | 0.001 004 4 | 125.76 | 0.4368 | 0.001 004 4 | 125.77 | 0.4368 | 30 |
| 35 | 0.001 006 0 | 146.66 | 0.5052 | 0.001 006 0 | 146.66 | 0.5052 | 0.001 006 0 | 146.67 | 0.5052 | 35 |
| 40 | 0.001 007 9 | 167.55 | 0.5724 | 0.001 007 9 | 167.56 | 0.5724 | 0.001 007 9 | 167.56 | 0.5724 | 40 |
| 45 | 0.001 009 9 | 188.45 | 0.6386 | 0.001 009 9 | 188.45 | 0.6386 | 0.001 009 9 | 188.46 | 0.6386 | 45 |
| 50 | 0.001 012 1 | 209.34 | 0.7038 | 0.001 012 1 | 209.35 | 0.7038 | 0.001 012 1 | 209.35 | 0.7038 | 50 |
| 55 | 0.001 014 5 | 230.24 | 0.7680 | 0.001 014 5 | 230.25 | 0.7680 | 0.001 014 5 | 230.25 | 0.7680 | 55 |
| 60 | 0.001 017 1 | 251.15 | 0.8312 | 0.001 017 1 | 251.16 | 0.8312 | 0.001 017 1 | 251.16 | 0.8312 | 60 |
| 65 | 7.7650 | 2618.6 | 7.9361 | 6.2041 | 2617.5 | 7.8304 | 0.001 019 9 | 272.08 | 0.8935 | 65 |
| 70 | 7.8828 | 2628.3 | 7.9646 | 6.2989 | 2627.4 | 7.8593 | 5.2429 | 2626.3 | 7.7727 | 70 |
| 75 | 8.0004 | 2638.0 | 7.9926 | 6.3935 | 2637.1 | 7.8875 | 5.3221 | 2636.2 | 7.8012 | 75 |
| 80 | 8.1178 | 2647.7 | 8.0202 | 6.4878 | 2646.9 | 7.9153 | 5.4011 | 2646.0 | 7.8292 | 80 |
| 85 | 8.2350 | 2657.3 | 8.0473 | 6.5819 | 2656.6 | 7.9426 | 5.4799 | 2655.8 | 7.8567 | 85 |
| 90 | 8.3520 | 2667.0 | 8.0740 | 6.6759 | 2666.2 | 7.9694 | 5.5585 | 2665.5 | 7.8837 | 90 |
| 95 | 8.4689 | 2676.6 | 8.1003 | 6.7697 | 2675.9 | 7.9958 | 5.6369 | 2675.2 | 7.9102 | 95 |
| 100 | 8.5857 | 2686.2 | 8.1262 | 6.8634 | 2685.6 | 8.0219 | 5.7153 | 2684.9 | 7.9364 | 100 |
| 105 | 8.7023 | 2695.8 | 8.1518 | 6.9570 | 2695.2 | 8.0476 | 5.7935 | 2694.6 | 7.9622 | 105 |
| 110 | 8.8189 | 2705.4 | 8.1770 | 7.0505 | 2704.9 | 8.0729 | 5.8716 | 2704.3 | 7.9876 | 110 |
| 115 | 8.9354 | 2715.0 | 8.2019 | 7.1439 | 2714.5 | 8.0979 | 5.9496 | 2714.0 | 8.0127 | 115 |
| 120 | 9.0518 | 2724.6 | 8.2265 | 7.2372 | 2724.1 | 8.1226 | 6.0275 | 2723.6 | 8.0374 | 120 |
| 125 | 9.1681 | 2734.2 | 8.2508 | 7.3305 | 2733.8 | 8.1469 | 6.1054 | 2733.3 | 8.0619 | 125 |
| 130 | 9.2843 | 2743.8 | 8.2748 | 7.4237 | 2743.4 | 8.1710 | 6.1832 | 2743.0 | 8.0860 | 130 |
| 135 | 9.4005 | 2753.4 | 8.2985 | 7.5168 | 2753.0 | 8.1947 | 6.2609 | 2752.6 | 8.1098 | 135 |
| 140 | 9.5167 | 2763.1 | 8.3219 | 7.6099 | 2762.7 | 8.2182 | 6.3386 | 2762.3 | 8.1333 | 140 |
| 145 | 9.6328 | 2772.7 | 8.3451 | 7.7029 | 2772.3 | 8.2414 | 6.4163 | 2771.9 | 8.1566 | 145 |
| 150 | 9.7488 | 2782.3 | 8.3680 | 7.7958 | 2782.0 | 8.2643 | 6.4939 | 2781.6 | 8.1796 | 150 |
| 155 | 9.8648 | 2792.0 | 8.3906 | 7.8888 | 2791.6 | 8.2870 | 6.5714 | 2791.3 | 8.2023 | 155 |
| 160 | 9.9808 | 2801.6 | 8.4130 | 7.9817 | 2801.3 | 8.3095 | 6.6489 | 2801.0 | 8.2248 | 160 |
| 165 | 10.097 | 2811.3 | 8.4352 | 8.0745 | 2811.0 | 8.3317 | 6.7264 | 2810.7 | 8.2470 | 165 |
| 170 | 10.213 | 2820.9 | 8.4571 | 8.1673 | 2820.6 | 8.3536 | 6.8038 | 2820.3 | 8.2690 | 170 |
| 175 | 10.328 | 2830.6 | 8.4788 | 8.2601 | 2830.3 | 8.3754 | 6.8812 | 2830.0 | 8.2907 | 175 |
| 180 | 10.444 | 2840.3 | 8.5003 | 8.3529 | 2840.0 | 8.3969 | 6.9586 | 2839.8 | 8.3123 | 180 |
| 185 | 10.560 | 2850.0 | 8.5216 | 8.4456 | 2849.7 | 8.4182 | 7.0360 | 2849.5 | 8.3336 | 185 |
| 190 | 10.676 | 2859.7 | 8.5427 | 8.5383 | 2859.4 | 8.4393 | 7.1133 | 2859.2 | 8.3547 | 190 |
| 195 | 10.792 | 2869.4 | 8.5635 | 8.6310 | 2869.2 | 8.4602 | 7.1906 | 2868.9 | 8.3756 | 195 |
| 200 | 10.907 | 2879.1 | 8.5842 | 8.7237 | 2878.9 | 8.4809 | 7.2679 | 2878.7 | 8.3964 | 200 |
| 205 | 11.023 | 2888.9 | 8.6047 | 8.8164 | 2888.7 | 8.5014 | 7.3452 | 2888.4 | 8.4169 | 205 |
| 210 | 11.139 | 2898.6 | 8.6250 | 8.9090 | 2898.4 | 8.5217 | 7.4224 | 2898.2 | 8.4372 | 210 |
| 215 | 11.255 | 2908.4 | 8.6451 | 9.0016 | 2908.2 | 8.5418 | 7.4997 | 2908.0 | 8.4573 | 215 |
| 220 | 11.370 | 2918.2 | 8.6650 | 9.0942 | 2918.0 | 8.5617 | 7.5769 | 2917.8 | 8.4773 | 220 |
| 225 | 11.486 | 2928.0 | 8.6848 | 9.1868 | 2927.8 | 8.5815 | 7.6541 | 2927.6 | 8.4971 | 225 |
| 230 | 11.602 | 2937.8 | 8.7044 | 9.2794 | 2937.6 | 8.6011 | 7.7313 | 2937.4 | 8.5167 | 230 |
| 235 | 11.717 | 2947.6 | 8.7238 | 9.3720 | 2947.4 | 8.6205 | 7.8085 | 2947.2 | 8.5361 | 235 |
| 240 | 11.833 | 2957.4 | 8.7430 | 9.4646 | 2957.3 | 8.6398 | 7.8857 | 2957.1 | 8.5554 | 240 |
| 245 | 11.949 | 2967.3 | 8.7621 | 9.5571 | 2967.1 | 8.6589 | 7.9628 | 2966.9 | 8.5745 | 245 |
| 250 | 12.064 | 2977.1 | 8.7811 | 9.6496 | 2977.0 | 8.6778 | 8.0400 | 2976.8 | 8.5935 | 250 |
| 255 | 12.180 | 2987.0 | 8.7998 | 9.7422 | 2986.8 | 8.6966 | 8.1171 | 2986.7 | 8.6123 | 255 |
| 260 | 12.295 | 2996.9 | 8.8185 | 9.8347 | 2996.7 | 8.7153 | 8.1943 | 2996.6 | 8.6309 | 260 |
| 265 | 12.411 | 3006.8 | 8.8369 | 9.9272 | 3006.6 | 8.7338 | 8.2714 | 3006.5 | 8.6494 | 265 |
| 270 | 12.526 | 3016.7 | 8.8553 | 10.020 | 3016.6 | 8.7521 | 8.3485 | 3016.4 | 8.6678 | 270 |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.020 MPa ($t_{sat}$ = 60.06 °C) | | | 0.025 MPa ($t_{sat}$ = 64.96 °C) | | | 0.030 MPa ($t_{sat}$ = 69.10 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 12.642 | 3026.6 | 8.8735 | 10.112 | 3026.5 | 8.7703 | 8.4256 | 3026.3 | 8.6860 | 275 |
| 280 | 12.758 | 3036.6 | 8.8915 | 10.205 | 3036.4 | 8.7884 | 8.5027 | 3036.3 | 8.7040 | 280 |
| 285 | 12.873 | 3046.5 | 8.9095 | 10.297 | 3046.4 | 8.8063 | 8.5798 | 3046.3 | 8.7220 | 285 |
| 290 | 12.989 | 3056.5 | 8.9273 | 10.390 | 3056.4 | 8.8241 | 8.6569 | 3056.2 | 8.7398 | 290 |
| 295 | 13.104 | 3066.5 | 8.9449 | 10.482 | 3066.4 | 8.8418 | 8.7340 | 3066.2 | 8.7575 | 295 |
| 300 | 13.220 | 3076.5 | 8.9624 | 10.575 | 3076.4 | 8.8593 | 8.8111 | 3076.2 | 8.7750 | 300 |
| 310 | 13.451 | 3096.5 | 8.9971 | 10.760 | 3096.4 | 8.8940 | 8.9652 | 3096.3 | 8.8097 | 310 |
| 320 | 13.682 | 3116.7 | 9.0313 | 10.944 | 3116.5 | 8.9282 | 9.1194 | 3116.4 | 8.8439 | 320 |
| 330 | 13.913 | 3136.8 | 9.0650 | 11.129 | 3136.7 | 8.9619 | 9.2735 | 3136.6 | 8.8776 | 330 |
| 340 | 14.144 | 3157.1 | 9.0983 | 11.314 | 3157.0 | 8.9952 | 9.4276 | 3156.9 | 8.9109 | 340 |
| 350 | 14.375 | 3177.4 | 9.1311 | 11.499 | 3177.3 | 9.0280 | 9.5816 | 3177.2 | 8.9438 | 350 |
| 360 | 14.606 | 3197.7 | 9.1635 | 11.684 | 3197.6 | 9.0605 | 9.7357 | 3197.5 | 8.9762 | 360 |
| 370 | 14.837 | 3218.1 | 9.1956 | 11.869 | 3218.0 | 9.0925 | 9.8898 | 3218.0 | 9.0082 | 370 |
| 380 | 15.068 | 3238.6 | 9.2272 | 12.053 | 3238.5 | 9.1241 | 10.044 | 3238.4 | 9.0398 | 380 |
| 390 | 15.299 | 3259.2 | 9.2584 | 12.238 | 3259.1 | 9.1553 | 10.198 | 3259.0 | 9.0711 | 390 |
| 400 | 15.530 | 3279.8 | 9.2892 | 12.423 | 3279.7 | 9.1862 | 10.352 | 3279.6 | 9.1019 | 400 |
| 410 | 15.761 | 3300.5 | 9.3197 | 12.608 | 3300.4 | 9.2167 | 10.506 | 3300.3 | 9.1324 | 410 |
| 420 | 15.992 | 3321.2 | 9.3499 | 12.793 | 3321.1 | 9.2468 | 10.660 | 3321.1 | 9.1626 | 420 |
| 430 | 16.223 | 3342.0 | 9.3797 | 12.977 | 3341.9 | 9.2766 | 10.814 | 3341.9 | 9.1924 | 430 |
| 440 | 16.453 | 3362.9 | 9.4092 | 13.162 | 3362.8 | 9.3061 | 10.968 | 3362.8 | 9.2219 | 440 |
| 450 | 16.684 | 3383.8 | 9.4383 | 13.347 | 3383.8 | 9.3353 | 11.122 | 3383.7 | 9.2511 | 450 |
| 460 | 16.915 | 3404.8 | 9.4672 | 13.532 | 3404.8 | 9.3641 | 11.276 | 3404.7 | 9.2799 | 460 |
| 470 | 17.146 | 3425.9 | 9.4957 | 13.716 | 3425.9 | 9.3927 | 11.430 | 3425.8 | 9.3085 | 470 |
| 480 | 17.377 | 3447.1 | 9.5240 | 13.901 | 3447.0 | 9.4210 | 11.584 | 3447.0 | 9.3368 | 480 |
| 490 | 17.608 | 3468.3 | 9.5520 | 14.086 | 3468.2 | 9.4489 | 11.738 | 3468.2 | 9.3647 | 490 |
| 500 | 17.839 | 3489.6 | 9.5797 | 14.270 | 3489.5 | 9.4767 | 11.892 | 3489.5 | 9.3925 | 500 |
| 510 | 18.070 | 3510.9 | 9.6071 | 14.455 | 3510.9 | 9.5041 | 12.046 | 3510.8 | 9.4199 | 510 |
| 520 | 18.300 | 3532.3 | 9.6343 | 14.640 | 3532.3 | 9.5313 | 12.199 | 3532.2 | 9.4471 | 520 |
| 530 | 18.531 | 3553.8 | 9.6612 | 14.825 | 3553.8 | 9.5582 | 12.353 | 3553.7 | 9.4740 | 530 |
| 540 | 18.762 | 3575.4 | 9.6879 | 15.009 | 3575.3 | 9.5849 | 12.507 | 3575.3 | 9.5007 | 540 |
| 550 | 18.993 | 3597.0 | 9.7143 | 15.194 | 3597.0 | 9.6113 | 12.661 | 3596.9 | 9.5271 | 550 |
| 560 | 19.224 | 3618.7 | 9.7405 | 15.379 | 3618.7 | 9.6375 | 12.815 | 3618.6 | 9.5533 | 560 |
| 570 | 19.455 | 3640.5 | 9.7665 | 15.563 | 3640.4 | 9.6635 | 12.969 | 3640.4 | 9.5793 | 570 |
| 580 | 19.686 | 3662.3 | 9.7923 | 15.748 | 3662.3 | 9.6892 | 13.123 | 3662.2 | 9.6050 | 580 |
| 590 | 19.916 | 3684.2 | 9.8178 | 15.933 | 3684.2 | 9.7148 | 13.277 | 3684.1 | 9.6306 | 590 |
| 600 | 20.147 | 3706.2 | 9.8431 | 16.117 | 3706.2 | 9.7401 | 13.431 | 3706.1 | 9.6559 | 600 |
| 610 | 20.378 | 3728.2 | 9.8682 | 16.302 | 3728.2 | 9.7652 | 13.585 | 3728.2 | 9.6810 | 610 |
| 620 | 20.609 | 3750.4 | 9.8931 | 16.487 | 3750.3 | 9.7901 | 13.739 | 3750.3 | 9.7059 | 620 |
| 630 | 20.840 | 3772.5 | 9.9178 | 16.671 | 3772.5 | 9.8148 | 13.893 | 3772.5 | 9.7306 | 630 |
| 640 | 21.071 | 3794.8 | 9.9423 | 16.856 | 3794.8 | 9.8393 | 14.046 | 3794.7 | 9.7551 | 640 |
| 650 | 21.301 | 3817.1 | 9.9666 | 17.041 | 3817.1 | 9.8636 | 14.200 | 3817.1 | 9.7795 | 650 |
| 660 | 21.532 | 3839.5 | 9.9908 | 17.225 | 3839.5 | 9.8878 | 14.354 | 3839.5 | 9.8036 | 660 |
| 670 | 21.763 | 3862.0 | 10.015 | 17.410 | 3862.0 | 9.9117 | 14.508 | 3861.9 | 9.8275 | 670 |
| 680 | 21.994 | 3884.6 | 10.039 | 17.595 | 3884.5 | 9.9355 | 14.662 | 3884.5 | 9.8513 | 680 |
| 690 | 22.225 | 3907.2 | 10.062 | 17.779 | 3907.1 | 9.9591 | 14.816 | 3907.1 | 9.8749 | 690 |
| 700 | 22.455 | 3929.8 | 10.086 | 17.964 | 3929.8 | 9.9825 | 14.970 | 3929.8 | 9.8984 | 700 |
| 710 | 22.686 | 3952.6 | 10.109 | 18.149 | 3952.6 | 10.006 | 15.124 | 3952.5 | 9.9216 | 710 |
| 720 | 22.917 | 3975.4 | 10.132 | 18.333 | 3975.4 | 10.029 | 15.278 | 3975.4 | 9.9447 | 720 |
| 730 | 23.148 | 3998.3 | 10.155 | 18.518 | 3998.3 | 10.052 | 15.431 | 3998.3 | 9.9677 | 730 |
| 740 | 23.379 | 4021.3 | 10.178 | 18.703 | 4021.3 | 10.075 | 15.585 | 4021.2 | 9.9904 | 740 |
| 750 | 23.609 | 4044.3 | 10.200 | 18.887 | 4044.3 | 10.097 | 15.739 | 4044.3 | 10.013 | 750 |
| 760 | 23.840 | 4067.4 | 10.223 | 19.072 | 4067.4 | 10.120 | 15.893 | 4067.4 | 10.036 | 760 |
| 770 | 24.071 | 4090.6 | 10.245 | 19.257 | 4090.6 | 10.142 | 16.047 | 4090.6 | 10.058 | 770 |
| 780 | 24.302 | 4113.9 | 10.267 | 19.441 | 4113.8 | 10.164 | 16.201 | 4113.8 | 10.080 | 780 |
| 790 | 24.533 | 4137.2 | 10.289 | 19.626 | 4137.2 | 10.186 | 16.355 | 4137.1 | 10.102 | 790 |
| 800 | 24.763 | 4160.6 | 10.311 | 19.811 | 4160.6 | 10.208 | 16.509 | 4160.5 | 10.124 | 800 |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 0.035 MPa ($t_{sat}$ = 72.68 °C) | | | 0.040 MPa ($t_{sat}$ = 75.86 °C) | | | 0.045 MPa ($t_{sat}$ = 78.71 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| Sat. Liq. | 0.001 024 4 | 304.25 | 0.9876 | 0.001 026 4 | 317.57 | 1.0259 | 0.001 028 2 | 329.55 | 1.0601 | Sat. Liq. |
| Sat. Vap. | 4.5252 | 2630.7 | 7.7146 | 3.9931 | 2636.1 | 7.6690 | 3.5761 | 2640.9 | 7.6288 | Sat. Vap. |
| 0 | 0.001 000 2 | -0.01 | -0.0002 | 0.001 000 2 | 0.00 | -0.0002 | 0.001 000 2 | 0.00 | -0.0002 | 0 |
| 5 | 0.001 000 1 | 21.05 | 0.0763 | 0.001 000 1 | 21.06 | 0.0763 | 0.001 000 1 | 21.06 | 0.0763 | 5 |
| 10 | 0.001 000 3 | 42.05 | 0.1511 | 0.001 000 3 | 42.06 | 0.1511 | 0.001 000 3 | 42.06 | 0.1511 | 10 |
| 15 | 0.001 000 9 | 63.02 | 0.2245 | 0.001 000 9 | 63.02 | 0.2245 | 0.001 000 9 | 63.03 | 0.2245 | 15 |
| 20 | 0.001 001 8 | 83.95 | 0.2965 | 0.001 001 8 | 83.96 | 0.2965 | 0.001 001 8 | 83.96 | 0.2965 | 20 |
| 25 | 0.001 003 0 | 104.87 | 0.3672 | 0.001 003 0 | 104.87 | 0.3672 | 0.001 003 0 | 104.88 | 0.3672 | 25 |
| 30 | 0.001 004 4 | 125.77 | 0.4368 | 0.001 004 4 | 125.78 | 0.4368 | 0.001 004 4 | 125.78 | 0.4368 | 30 |
| 35 | 0.001 006 0 | 146.67 | 0.5052 | 0.001 006 0 | 146.68 | 0.5052 | 0.001 006 0 | 146.68 | 0.5052 | 35 |
| 40 | 0.001 007 9 | 167.57 | 0.5724 | 0.001 007 9 | 167.57 | 0.5724 | 0.001 007 9 | 167.57 | 0.5724 | 40 |
| 45 | 0.001 009 9 | 188.46 | 0.6386 | 0.001 009 9 | 188.46 | 0.6386 | 0.001 009 9 | 188.47 | 0.6386 | 45 |
| 50 | 0.001 012 1 | 209.36 | 0.7038 | 0.001 012 1 | 209.36 | 0.7038 | 0.001 012 1 | 209.36 | 0.7038 | 50 |
| 55 | 0.001 014 5 | 230.26 | 0.7680 | 0.001 014 5 | 230.26 | 0.7680 | 0.001 014 5 | 230.27 | 0.7680 | 55 |
| 60 | 0.001 017 1 | 251.17 | 0.8312 | 0.001 017 1 | 251.17 | 0.8312 | 0.001 017 1 | 251.18 | 0.8312 | 60 |
| 65 | 0.001 019 8 | 272.09 | 0.8935 | 0.001 019 8 | 272.09 | 0.8935 | 0.001 019 8 | 272.10 | 0.8935 | 65 |
| 70 | 0.001 022 8 | 293.02 | 0.9550 | 0.001 022 8 | 293.03 | 0.9550 | 0.001 022 8 | 293.03 | 0.9550 | 70 |
| 75 | 4.5569 | 2635.3 | 7.7279 | 0.001 025 8 | 313.97 | 1.0156 | 0.001 025 8 | 313.98 | 1.0156 | 75 |
| 80 | 4.6249 | 2645.2 | 7.7561 | 4.0427 | 2644.3 | 7.6925 | 3.5898 | 2643.4 | 7.6361 | 80 |
| 85 | 4.6927 | 2655.0 | 7.7838 | 4.1022 | 2654.2 | 7.7203 | 3.6430 | 2653.4 | 7.6642 | 85 |
| 90 | 4.7603 | 2664.8 | 7.8109 | 4.1616 | 2664.1 | 7.7477 | 3.6960 | 2663.3 | 7.6917 | 90 |
| 95 | 4.8278 | 2674.6 | 7.8376 | 4.2209 | 2673.9 | 7.7745 | 3.7488 | 2673.2 | 7.7187 | 95 |
| 100 | 4.8951 | 2684.3 | 7.8639 | 4.2800 | 2683.7 | 7.8009 | 3.8015 | 2683.0 | 7.7452 | 100 |
| 105 | 4.9623 | 2694.0 | 7.8898 | 4.3390 | 2693.4 | 7.8269 | 3.8541 | 2692.8 | 7.7713 | 105 |
| 110 | 5.0295 | 2703.8 | 7.9153 | 4.3979 | 2703.2 | 7.8525 | 3.9066 | 2702.6 | 7.7970 | 110 |
| 115 | 5.0965 | 2713.5 | 7.9405 | 4.4567 | 2712.9 | 7.8778 | 3.9590 | 2712.4 | 7.8224 | 115 |
| 120 | 5.1635 | 2723.1 | 7.9653 | 4.5154 | 2722.7 | 7.9027 | 4.0113 | 2722.2 | 7.8473 | 120 |
| 125 | 5.2304 | 2732.8 | 7.9898 | 4.5740 | 2732.4 | 7.9273 | 4.0636 | 2731.9 | 7.8720 | 125 |
| 130 | 5.2972 | 2742.5 | 8.0140 | 4.6326 | 2742.1 | 7.9515 | 4.1157 | 2741.6 | 7.8963 | 130 |
| 135 | 5.3639 | 2752.2 | 8.0379 | 4.6911 | 2751.8 | 7.9754 | 4.1679 | 2751.4 | 7.9203 | 135 |
| 140 | 5.4306 | 2761.9 | 8.0614 | 4.7496 | 2761.5 | 7.9991 | 4.2199 | 2761.1 | 7.9440 | 140 |
| 145 | 5.4973 | 2771.6 | 8.0847 | 4.8080 | 2771.2 | 8.0224 | 4.2719 | 2770.8 | 7.9674 | 145 |
| 150 | 5.5639 | 2781.3 | 8.1078 | 4.8664 | 2780.9 | 8.0455 | 4.3239 | 2780.6 | 7.9905 | 150 |
| 155 | 5.6304 | 2791.0 | 8.1305 | 4.9247 | 2790.6 | 8.0683 | 4.3758 | 2790.3 | 8.0133 | 155 |
| 160 | 5.6969 | 2800.6 | 8.1530 | 4.9830 | 2800.3 | 8.0908 | 4.4276 | 2800.0 | 8.0359 | 160 |
| 165 | 5.7634 | 2810.3 | 8.1753 | 5.0412 | 2810.0 | 8.1131 | 4.4795 | 2809.7 | 8.0582 | 165 |
| 170 | 5.8299 | 2820.1 | 8.1973 | 5.0994 | 2819.8 | 8.1352 | 4.5313 | 2819.5 | 8.0803 | 170 |
| 175 | 5.8963 | 2829.8 | 8.2191 | 5.1576 | 2829.5 | 8.1570 | 4.5831 | 2829.2 | 8.1022 | 175 |
| 180 | 5.9627 | 2839.5 | 8.2407 | 5.2158 | 2839.2 | 8.1786 | 4.6348 | 2839.0 | 8.1238 | 180 |
| 185 | 6.0291 | 2849.2 | 8.2620 | 5.2739 | 2849.0 | 8.2000 | 4.6865 | 2848.7 | 8.1452 | 185 |
| 190 | 6.0954 | 2859.0 | 8.2832 | 5.3320 | 2858.7 | 8.2212 | 4.7382 | 2858.5 | 8.1664 | 190 |
| 195 | 6.1617 | 2868.7 | 8.3041 | 5.3901 | 2868.5 | 8.2421 | 4.7899 | 2868.2 | 8.1874 | 195 |
| 200 | 6.2280 | 2878.5 | 8.3248 | 5.4481 | 2878.2 | 8.2629 | 4.8415 | 2878.0 | 8.2081 | 200 |
| 205 | 6.2943 | 2888.2 | 8.3454 | 5.5062 | 2888.0 | 8.2834 | 4.8932 | 2887.8 | 8.2287 | 205 |
| 210 | 6.3606 | 2898.0 | 8.3657 | 5.5642 | 2897.8 | 8.3038 | 4.9448 | 2897.6 | 8.2491 | 210 |
| 215 | 6.4268 | 2907.8 | 8.3859 | 5.6222 | 2907.6 | 8.3239 | 4.9964 | 2907.4 | 8.2693 | 215 |
| 220 | 6.4931 | 2917.6 | 8.4059 | 5.6802 | 2917.4 | 8.3439 | 5.0480 | 2917.2 | 8.2893 | 220 |
| 225 | 6.5593 | 2927.4 | 8.4256 | 5.7382 | 2927.2 | 8.3637 | 5.0996 | 2927.0 | 8.3091 | 225 |
| 230 | 6.6255 | 2937.2 | 8.4453 | 5.7962 | 2937.0 | 8.3834 | 5.1511 | 2936.9 | 8.3287 | 230 |
| 235 | 6.6917 | 2947.1 | 8.4647 | 5.8541 | 2946.9 | 8.4028 | 5.2027 | 2946.7 | 8.3482 | 235 |
| 240 | 6.7579 | 2956.9 | 8.4840 | 5.9121 | 2956.7 | 8.4221 | 5.2542 | 2956.6 | 8.3675 | 240 |
| 245 | 6.8241 | 2966.8 | 8.5031 | 5.9700 | 2966.6 | 8.4413 | 5.3057 | 2966.4 | 8.3867 | 245 |
| 250 | 6.8902 | 2976.6 | 8.5221 | 6.0279 | 2976.5 | 8.4602 | 5.3572 | 2976.3 | 8.4056 | 250 |
| 255 | 6.9564 | 2986.5 | 8.5409 | 6.0858 | 2986.4 | 8.4791 | 5.4087 | 2986.2 | 8.4245 | 255 |
| 260 | 7.0225 | 2996.4 | 8.5596 | 6.1437 | 2996.3 | 8.4977 | 5.4602 | 2996.1 | 8.4431 | 260 |
| 265 | 7.0887 | 3006.3 | 8.5781 | 6.2016 | 3006.2 | 8.5162 | 5.5117 | 3006.0 | 8.4617 | 265 |
| 270 | 7.1548 | 3016.3 | 8.5964 | 6.2595 | 3016.1 | 8.5346 | 5.5632 | 3016.0 | 8.4800 | 270 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.035 MPa ($t_{sat}$ = 72.68 °C) | | | 0.040 MPa ($t_{sat}$ = 75.86 °C) | | | 0.045 MPa ($t_{sat}$ = 78.71 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 7.2209 | 3026.2 | 8.6146 | 6.3174 | 3026.1 | 8.5528 | 5.6147 | 3025.9 | 8.4983 | 275 |
| 280 | 7.2871 | 3036.2 | 8.6327 | 6.3753 | 3036.0 | 8.5709 | 5.6661 | 3035.9 | 8.5164 | 280 |
| 285 | 7.3532 | 3046.1 | 8.6507 | 6.4332 | 3046.0 | 8.5889 | 5.7176 | 3045.9 | 8.5343 | 285 |
| 290 | 7.4193 | 3056.1 | 8.6685 | 6.4910 | 3056.0 | 8.6067 | 5.7691 | 3055.9 | 8.5521 | 290 |
| 295 | 7.4854 | 3066.1 | 8.6861 | 6.5489 | 3066.0 | 8.6244 | 5.8205 | 3065.9 | 8.5698 | 295 |
| 300 | 7.5515 | 3076.1 | 8.7037 | 6.6067 | 3076.0 | 8.6419 | 5.8719 | 3075.9 | 8.5874 | 300 |
| 310 | 7.6836 | 3096.2 | 8.7384 | 6.7224 | 3096.1 | 8.6766 | 5.9748 | 3096.0 | 8.6221 | 310 |
| 320 | 7.8158 | 3116.3 | 8.7726 | 6.8381 | 3116.2 | 8.7109 | 6.0777 | 3116.1 | 8.6564 | 320 |
| 330 | 7.9479 | 3136.5 | 8.8064 | 6.9537 | 3136.4 | 8.7446 | 6.1805 | 3136.3 | 8.6901 | 330 |
| 340 | 8.0800 | 3156.8 | 8.8397 | 7.0694 | 3156.7 | 8.7779 | 6.2833 | 3156.6 | 8.7234 | 340 |
| 350 | 8.2121 | 3177.1 | 8.8725 | 7.1850 | 3177.0 | 8.8108 | 6.3861 | 3176.9 | 8.7563 | 350 |
| 360 | 8.3442 | 3197.4 | 8.9050 | 7.3006 | 3197.3 | 8.8432 | 6.4889 | 3197.3 | 8.7888 | 360 |
| 370 | 8.4763 | 3217.9 | 8.9370 | 7.4162 | 3217.8 | 8.8752 | 6.5916 | 3217.7 | 8.8208 | 370 |
| 380 | 8.6083 | 3238.4 | 8.9686 | 7.5317 | 3238.3 | 8.9069 | 6.6944 | 3238.2 | 8.8524 | 380 |
| 390 | 8.7404 | 3258.9 | 8.9998 | 7.6473 | 3258.8 | 8.9381 | 6.7971 | 3258.8 | 8.8837 | 390 |
| 400 | 8.8724 | 3279.5 | 9.0307 | 7.7629 | 3279.5 | 8.9690 | 6.8999 | 3279.4 | 8.9145 | 400 |
| 410 | 9.0045 | 3300.2 | 9.0612 | 7.8784 | 3300.2 | 8.9995 | 7.0026 | 3300.1 | 8.9451 | 410 |
| 420 | 9.1365 | 3321.0 | 9.0914 | 7.9940 | 3320.9 | 9.0297 | 7.1053 | 3320.8 | 8.9752 | 420 |
| 430 | 9.2685 | 3341.8 | 9.1212 | 8.1095 | 3341.7 | 9.0595 | 7.2080 | 3341.7 | 9.0051 | 430 |
| 440 | 9.4005 | 3362.7 | 9.1507 | 8.2250 | 3362.6 | 9.0890 | 7.3107 | 3362.6 | 9.0346 | 440 |
| 450 | 9.5325 | 3383.6 | 9.1799 | 8.3405 | 3383.6 | 9.1182 | 7.4134 | 3383.5 | 9.0637 | 450 |
| 460 | 9.6645 | 3404.7 | 9.2087 | 8.4560 | 3404.6 | 9.1470 | 7.5161 | 3404.5 | 9.0926 | 460 |
| 470 | 9.7965 | 3425.7 | 9.2373 | 8.5715 | 3425.7 | 9.1756 | 7.6188 | 3425.6 | 9.1212 | 470 |
| 480 | 9.9285 | 3446.9 | 9.2656 | 8.6870 | 3446.8 | 9.2039 | 7.7215 | 3446.8 | 9.1495 | 480 |
| 490 | 10.060 | 3468.1 | 9.2935 | 8.8025 | 3468.1 | 9.2319 | 7.8242 | 3468.0 | 9.1774 | 490 |
| 500 | 10.192 | 3489.4 | 9.3213 | 8.9180 | 3489.4 | 9.2596 | 7.9268 | 3489.3 | 9.2052 | 500 |
| 510 | 10.324 | 3510.8 | 9.3487 | 9.0335 | 3510.7 | 9.2870 | 8.0295 | 3510.7 | 9.2326 | 510 |
| 520 | 10.456 | 3532.2 | 9.3759 | 9.1490 | 3532.1 | 9.3142 | 8.1321 | 3532.1 | 9.2598 | 520 |
| 530 | 10.588 | 3553.7 | 9.4028 | 9.2645 | 3553.6 | 9.3411 | 8.2348 | 3553.6 | 9.2867 | 530 |
| 540 | 10.720 | 3575.2 | 9.4295 | 9.3799 | 3575.2 | 9.3678 | 8.3375 | 3575.1 | 9.3134 | 540 |
| 550 | 10.852 | 3596.9 | 9.4559 | 9.4954 | 3596.8 | 9.3943 | 8.4401 | 3596.8 | 9.3399 | 550 |
| 560 | 10.984 | 3618.6 | 9.4821 | 9.6109 | 3618.5 | 9.4205 | 8.5427 | 3618.5 | 9.3661 | 560 |
| 570 | 11.116 | 3640.3 | 9.5081 | 9.7263 | 3640.3 | 9.4464 | 8.6454 | 3640.3 | 9.3921 | 570 |
| 580 | 11.248 | 3662.2 | 9.5339 | 9.8418 | 3662.1 | 9.4722 | 8.7480 | 3662.1 | 9.4178 | 580 |
| 590 | 11.380 | 3684.1 | 9.5594 | 9.9572 | 3684.1 | 9.4977 | 8.8506 | 3684.0 | 9.4433 | 590 |
| 600 | 11.512 | 3706.1 | 9.5847 | 10.073 | 3706.0 | 9.5231 | 8.9533 | 3706.0 | 9.4687 | 600 |
| 610 | 11.644 | 3728.1 | 9.6098 | 10.188 | 3728.1 | 9.5482 | 9.0559 | 3728.1 | 9.4938 | 610 |
| 620 | 11.776 | 3750.2 | 9.6347 | 10.304 | 3750.2 | 9.5731 | 9.1585 | 3750.2 | 9.5187 | 620 |
| 630 | 11.908 | 3772.4 | 9.6594 | 10.419 | 3772.4 | 9.5978 | 9.2612 | 3772.4 | 9.5434 | 630 |
| 640 | 12.040 | 3794.7 | 9.6840 | 10.534 | 3794.7 | 9.6223 | 9.3638 | 3794.6 | 9.5679 | 640 |
| 650 | 12.172 | 3817.0 | 9.7083 | 10.650 | 3817.0 | 9.6466 | 9.4664 | 3817.0 | 9.5922 | 650 |
| 660 | 12.303 | 3839.4 | 9.7324 | 10.765 | 3839.4 | 9.6708 | 9.5690 | 3839.4 | 9.6164 | 660 |
| 670 | 12.435 | 3861.9 | 9.7564 | 10.881 | 3861.9 | 9.6947 | 9.6716 | 3861.9 | 9.6403 | 670 |
| 680 | 12.567 | 3884.5 | 9.7802 | 10.996 | 3884.4 | 9.7185 | 9.7742 | 3884.4 | 9.6641 | 680 |
| 690 | 12.699 | 3907.1 | 9.8038 | 11.112 | 3907.0 | 9.7421 | 9.8768 | 3907.0 | 9.6877 | 690 |
| 700 | 12.831 | 3929.8 | 9.8272 | 11.227 | 3929.7 | 9.7655 | 9.9795 | 3929.7 | 9.7112 | 700 |
| 710 | 12.963 | 3952.5 | 9.8505 | 11.342 | 3952.5 | 9.7888 | 10.082 | 3952.5 | 9.7344 | 710 |
| 720 | 13.095 | 3975.3 | 9.8736 | 11.458 | 3975.3 | 9.8119 | 10.185 | 3975.3 | 9.7575 | 720 |
| 730 | 13.227 | 3998.2 | 9.8965 | 11.573 | 3998.2 | 9.8349 | 10.287 | 3998.2 | 9.7805 | 730 |
| 740 | 13.359 | 4021.2 | 9.9193 | 11.689 | 4021.2 | 9.8576 | 10.390 | 4021.2 | 9.8033 | 740 |
| 750 | 13.491 | 4044.3 | 9.9419 | 11.804 | 4044.2 | 9.8803 | 10.492 | 4044.2 | 9.8259 | 750 |
| 760 | 13.623 | 4067.4 | 9.9644 | 11.920 | 4067.3 | 9.9027 | 10.595 | 4067.3 | 9.8484 | 760 |
| 770 | 13.754 | 4090.5 | 9.9867 | 12.035 | 4090.5 | 9.9251 | 10.698 | 4090.5 | 9.8707 | 770 |
| 780 | 13.886 | 4113.8 | 10.009 | 12.150 | 4113.8 | 9.9473 | 10.800 | 4113.7 | 9.8929 | 780 |
| 790 | 14.018 | 4137.1 | 10.031 | 12.266 | 4137.1 | 9.9693 | 10.903 | 4137.1 | 9.9149 | 790 |
| 800 | 14.150 | 4160.5 | 10.053 | 12.381 | 4160.5 | 9.9912 | 11.005 | 4160.5 | 9.9368 | 800 |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.05 MPa ($t_{sat}$ = 81.32 °C) | | | 0.06 MPa ($t_{sat}$ = 85.93 °C) | | | 0.07 MPa ($t_{sat}$ = 89.93 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 029 9 | 340.48 | 1.0910 | 0.001 033 1 | 359.84 | 1.1452 | 0.001 035 9 | 376.68 | 1.1919 | Sat. Liq. |
| Sat. Vap. | 3.2401 | 2645.2 | 7.5930 | 2.7318 | 2652.9 | 7.5311 | 2.3649 | 2659.4 | 7.4790 | Sat. Vap. |
| 0 | 0.001 000 2 | 0.01 | -0.0002 | 0.001 000 2 | 0.02 | -0.0002 | 0.001 000 2 | 0.03 | -0.0001 | 0 |
| 5 | 0.001 000 1 | 21.07 | 0.0763 | 0.001 000 1 | 21.08 | 0.0763 | 0.001 000 0 | 21.09 | 0.0763 | 5 |
| 10 | 0.001 000 3 | 42.07 | 0.1511 | 0.001 000 3 | 42.08 | 0.1511 | 0.001 000 3 | 42.09 | 0.1511 | 10 |
| 15 | 0.001 000 9 | 63.03 | 0.2245 | 0.001 000 9 | 63.04 | 0.2245 | 0.001 000 9 | 63.05 | 0.2245 | 15 |
| 20 | 0.001 001 8 | 83.96 | 0.2965 | 0.001 001 8 | 83.97 | 0.2965 | 0.001 001 8 | 83.98 | 0.2965 | 20 |
| 25 | 0.001 003 0 | 104.88 | 0.3672 | 0.001 003 0 | 104.89 | 0.3672 | 0.001 003 0 | 104.90 | 0.3672 | 25 |
| 30 | 0.001 004 4 | 125.79 | 0.4368 | 0.001 004 4 | 125.80 | 0.4368 | 0.001 004 4 | 125.81 | 0.4368 | 30 |
| 35 | 0.001 006 0 | 146.68 | 0.5052 | 0.001 006 0 | 146.69 | 0.5051 | 0.001 006 0 | 146.70 | 0.5051 | 35 |
| 40 | 0.001 007 9 | 167.58 | 0.5724 | 0.001 007 9 | 167.59 | 0.5724 | 0.001 007 9 | 167.60 | 0.5724 | 40 |
| 45 | 0.001 009 9 | 188.47 | 0.6386 | 0.001 009 9 | 188.48 | 0.6386 | 0.001 009 9 | 188.49 | 0.6386 | 45 |
| 50 | 0.001 012 1 | 209.37 | 0.7038 | 0.001 012 1 | 209.38 | 0.7038 | 0.001 012 1 | 209.39 | 0.7038 | 50 |
| 55 | 0.001 014 5 | 230.27 | 0.7680 | 0.001 014 5 | 230.28 | 0.7680 | 0.001 014 5 | 230.29 | 0.7680 | 55 |
| 60 | 0.001 017 1 | 251.18 | 0.8312 | 0.001 017 1 | 251.19 | 0.8312 | 0.001 017 1 | 251.20 | 0.8312 | 60 |
| 65 | 0.001 019 8 | 272.10 | 0.8935 | 0.001 019 8 | 272.11 | 0.8935 | 0.001 019 8 | 272.12 | 0.8935 | 65 |
| 70 | 0.001 022 7 | 293.03 | 0.9550 | 0.001 022 7 | 293.04 | 0.9550 | 0.001 022 7 | 293.05 | 0.9550 | 70 |
| 75 | 0.001 025 8 | 313.98 | 1.0156 | 0.001 025 8 | 313.99 | 1.0156 | 0.001 025 8 | 314.00 | 1.0156 | 75 |
| 80 | 0.001 029 0 | 334.95 | 1.0754 | 0.001 029 0 | 334.96 | 1.0754 | 0.001 029 0 | 334.97 | 1.0754 | 80 |
| 85 | 3.2756 | 2652.6 | 7.6137 | 0.001 032 4 | 355.95 | 1.1344 | 0.001 032 4 | 355.96 | 1.1344 | 85 |
| 90 | 3.3235 | 2662.6 | 7.6414 | 2.7646 | 2661.1 | 7.5539 | 2.3654 | 2659.6 | 7.4793 | 90 |
| 95 | 3.3712 | 2672.5 | 7.6685 | 2.8047 | 2671.1 | 7.5814 | 2.4000 | 2669.7 | 7.5071 | 95 |
| 100 | 3.4188 | 2682.4 | 7.6952 | 2.8446 | 2681.1 | 7.6083 | 2.4344 | 2679.8 | 7.5343 | 100 |
| 105 | 3.4663 | 2692.2 | 7.7214 | 2.8844 | 2691.0 | 7.6347 | 2.4688 | 2689.8 | 7.5610 | 105 |
| 110 | 3.5136 | 2702.1 | 7.7472 | 2.9241 | 2700.9 | 7.6608 | 2.5030 | 2699.8 | 7.5872 | 110 |
| 115 | 3.5609 | 2711.9 | 7.7727 | 2.9637 | 2710.8 | 7.6864 | 2.5371 | 2709.8 | 7.6130 | 115 |
| 120 | 3.6081 | 2721.7 | 7.7977 | 3.0032 | 2720.7 | 7.7116 | 2.5711 | 2719.7 | 7.6384 | 120 |
| 125 | 3.6552 | 2731.4 | 7.8224 | 3.0426 | 2730.5 | 7.7364 | 2.6050 | 2729.6 | 7.6634 | 125 |
| 130 | 3.7022 | 2741.2 | 7.8468 | 3.0820 | 2740.3 | 7.7609 | 2.6389 | 2739.4 | 7.6880 | 130 |
| 135 | 3.7492 | 2751.0 | 7.8709 | 3.1213 | 2750.1 | 7.7851 | 2.6727 | 2749.3 | 7.7123 | 135 |
| 140 | 3.7962 | 2760.7 | 7.8946 | 3.1605 | 2759.9 | 7.8089 | 2.7065 | 2759.1 | 7.7363 | 140 |
| 145 | 3.8430 | 2770.5 | 7.9180 | 3.1997 | 2769.7 | 7.8325 | 2.7402 | 2768.9 | 7.7599 | 145 |
| 150 | 3.8899 | 2780.2 | 7.9412 | 3.2388 | 2779.5 | 7.8557 | 2.7738 | 2778.8 | 7.7833 | 150 |
| 155 | 3.9366 | 2789.9 | 7.9641 | 3.2779 | 2789.3 | 7.8787 | 2.8074 | 2788.6 | 7.8063 | 155 |
| 160 | 3.9834 | 2799.7 | 7.9867 | 3.3170 | 2799.0 | 7.9014 | 2.8410 | 2798.4 | 7.8291 | 160 |
| 165 | 4.0301 | 2809.4 | 8.0091 | 3.3560 | 2808.8 | 7.9239 | 2.8745 | 2808.2 | 7.8516 | 165 |
| 170 | 4.0768 | 2819.2 | 8.0312 | 3.3950 | 2818.6 | 7.9460 | 2.9080 | 2818.0 | 7.8739 | 170 |
| 175 | 4.1234 | 2828.9 | 8.0531 | 3.4339 | 2828.4 | 7.9680 | 2.9415 | 2827.8 | 7.8959 | 175 |
| 180 | 4.1700 | 2838.7 | 8.0747 | 3.4729 | 2838.1 | 7.9897 | 2.9749 | 2837.6 | 7.9176 | 180 |
| 185 | 4.2166 | 2848.4 | 8.0962 | 3.5118 | 2847.9 | 8.0112 | 3.0083 | 2847.4 | 7.9391 | 185 |
| 190 | 4.2632 | 2858.2 | 8.1174 | 3.5507 | 2857.7 | 8.0324 | 3.0417 | 2857.2 | 7.9604 | 190 |
| 195 | 4.3097 | 2868.0 | 8.1384 | 3.5895 | 2867.5 | 8.0534 | 3.0751 | 2867.0 | 7.9815 | 195 |
| 200 | 4.3563 | 2877.8 | 8.1591 | 3.6283 | 2877.3 | 8.0743 | 3.1084 | 2876.9 | 8.0024 | 200 |
| 205 | 4.4028 | 2887.6 | 8.1797 | 3.6672 | 2887.1 | 8.0949 | 3.1417 | 2886.7 | 8.0230 | 205 |
| 210 | 4.4493 | 2897.4 | 8.2001 | 3.7060 | 2896.9 | 8.1153 | 3.1750 | 2896.5 | 8.0435 | 210 |
| 215 | 4.4957 | 2907.2 | 8.2203 | 3.7447 | 2906.8 | 8.1355 | 3.2083 | 2906.4 | 8.0638 | 215 |
| 220 | 4.5422 | 2917.0 | 8.2403 | 3.7835 | 2916.6 | 8.1556 | 3.2416 | 2916.2 | 8.0838 | 220 |
| 225 | 4.5886 | 2926.8 | 8.2602 | 3.8223 | 2926.5 | 8.1755 | 3.2749 | 2926.1 | 8.1037 | 225 |
| 230 | 4.6351 | 2936.7 | 8.2798 | 3.8610 | 2936.3 | 8.1951 | 3.3081 | 2935.9 | 8.1234 | 230 |
| 235 | 4.6815 | 2946.5 | 8.2993 | 3.8997 | 2946.2 | 8.2147 | 3.3413 | 2945.8 | 8.1430 | 235 |
| 240 | 4.7279 | 2956.4 | 8.3186 | 3.9385 | 2956.0 | 8.2340 | 3.3746 | 2955.7 | 8.1623 | 240 |
| 245 | 4.7743 | 2966.3 | 8.3378 | 3.9772 | 2965.9 | 8.2532 | 3.4078 | 2965.6 | 8.1815 | 245 |
| 250 | 4.8207 | 2976.2 | 8.3568 | 4.0159 | 2975.8 | 8.2722 | 3.4410 | 2975.5 | 8.2006 | 250 |
| 255 | 4.8671 | 2986.1 | 8.3756 | 4.0545 | 2985.7 | 8.2910 | 3.4742 | 2985.4 | 8.2195 | 255 |
| 260 | 4.9134 | 2996.0 | 8.3943 | 4.0932 | 2995.7 | 8.3097 | 3.5074 | 2995.4 | 8.2382 | 260 |
| 265 | 4.9598 | 3005.9 | 8.4128 | 4.1319 | 3005.6 | 8.3283 | 3.5405 | 3005.3 | 8.2567 | 265 |
| 270 | 5.0061 | 3015.8 | 8.4312 | 4.1705 | 3015.6 | 8.3467 | 3.5737 | 3015.3 | 8.2751 | 270 |

**UNITS**: $v$ in $m^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 0.05 MPa ($t_{sat}$ = 81.32 °C) | | | 0.06 MPa ($t_{sat}$ = 85.93 °C) | | | 0.07 MPa ($t_{sat}$ = 89.93 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| 275 | 5.0525 | 3025.8 | 8.4495 | 4.2092 | 3025.5 | 8.3649 | 3.6069 | 3025.2 | 8.2934 | 275 |
| 280 | 5.0988 | 3035.8 | 8.4676 | 4.2478 | 3035.5 | 8.3831 | 3.6400 | 3035.2 | 8.3115 | 280 |
| 285 | 5.1452 | 3045.7 | 8.4855 | 4.2865 | 3045.5 | 8.4010 | 3.6731 | 3045.2 | 8.3295 | 285 |
| 290 | 5.1915 | 3055.7 | 8.5034 | 4.3251 | 3055.5 | 8.4189 | 3.7063 | 3055.2 | 8.3474 | 290 |
| 295 | 5.2378 | 3065.7 | 8.5210 | 4.3637 | 3065.5 | 8.4366 | 3.7394 | 3065.2 | 8.3651 | 295 |
| 300 | 5.2841 | 3075.8 | 8.5386 | 4.4024 | 3075.5 | 8.4541 | 3.7725 | 3075.3 | 8.3827 | 300 |
| 310 | 5.3767 | 3095.8 | 8.5733 | 4.4796 | 3095.6 | 8.4889 | 3.8388 | 3095.4 | 8.4175 | 310 |
| 320 | 5.4693 | 3116.0 | 8.6076 | 4.5568 | 3115.8 | 8.5232 | 3.9050 | 3115.5 | 8.4518 | 320 |
| 330 | 5.5619 | 3136.2 | 8.6414 | 4.6340 | 3136.0 | 8.5570 | 3.9712 | 3135.8 | 8.4856 | 330 |
| 340 | 5.6544 | 3156.5 | 8.6747 | 4.7112 | 3156.3 | 8.5903 | 4.0374 | 3156.1 | 8.5189 | 340 |
| 350 | 5.7470 | 3176.8 | 8.7076 | 4.7883 | 3176.6 | 8.6232 | 4.1035 | 3176.4 | 8.5518 | 350 |
| 360 | 5.8395 | 3197.2 | 8.7400 | 4.8655 | 3197.0 | 8.6557 | 4.1697 | 3196.8 | 8.5843 | 360 |
| 370 | 5.9320 | 3217.6 | 8.7721 | 4.9426 | 3217.4 | 8.6877 | 4.2358 | 3217.3 | 8.6164 | 370 |
| 380 | 6.0245 | 3238.1 | 8.8037 | 5.0197 | 3237.9 | 8.7194 | 4.3020 | 3237.8 | 8.6480 | 380 |
| 390 | 6.1170 | 3258.7 | 8.8349 | 5.0968 | 3258.5 | 8.7506 | 4.3681 | 3258.4 | 8.6793 | 390 |
| 400 | 6.2095 | 3279.3 | 8.8658 | 5.1739 | 3279.2 | 8.7815 | 4.4342 | 3279.0 | 8.7102 | 400 |
| 410 | 6.3020 | 3300.0 | 8.8964 | 5.2510 | 3299.9 | 8.8120 | 4.5003 | 3299.7 | 8.7407 | 410 |
| 420 | 6.3944 | 3320.8 | 8.9265 | 5.3281 | 3320.6 | 8.8422 | 4.5664 | 3320.5 | 8.7709 | 420 |
| 430 | 6.4869 | 3341.6 | 8.9564 | 5.4051 | 3341.5 | 8.8721 | 4.6325 | 3341.3 | 8.8008 | 430 |
| 440 | 6.5793 | 3362.5 | 8.9859 | 5.4822 | 3362.4 | 8.9016 | 4.6985 | 3362.2 | 8.8303 | 440 |
| 450 | 6.6718 | 3383.5 | 9.0150 | 5.5593 | 3383.3 | 8.9308 | 4.7646 | 3383.2 | 8.8595 | 450 |
| 460 | 6.7642 | 3404.5 | 9.0439 | 5.6363 | 3404.4 | 8.9596 | 4.8307 | 3404.2 | 8.8884 | 460 |
| 470 | 6.8566 | 3425.6 | 9.0725 | 5.7133 | 3425.4 | 8.9882 | 4.8967 | 3425.3 | 8.9170 | 470 |
| 480 | 6.9490 | 3446.7 | 9.1008 | 5.7904 | 3446.6 | 9.0165 | 4.9628 | 3446.5 | 8.9453 | 480 |
| 490 | 7.0415 | 3468.0 | 9.1288 | 5.8674 | 3467.8 | 9.0445 | 5.0288 | 3467.7 | 8.9733 | 490 |
| 500 | 7.1339 | 3489.2 | 9.1565 | 5.9444 | 3489.1 | 9.0722 | 5.0949 | 3489.0 | 9.0010 | 500 |
| 510 | 7.2263 | 3510.6 | 9.1839 | 6.0215 | 3510.5 | 9.0997 | 5.1609 | 3510.4 | 9.0285 | 510 |
| 520 | 7.3187 | 3532.0 | 9.2111 | 6.0985 | 3531.9 | 9.1269 | 5.2269 | 3531.8 | 9.0556 | 520 |
| 530 | 7.4111 | 3553.5 | 9.2381 | 6.1755 | 3553.4 | 9.1538 | 5.2929 | 3553.3 | 9.0826 | 530 |
| 540 | 7.5035 | 3575.1 | 9.2648 | 6.2525 | 3575.0 | 9.1805 | 5.3590 | 3574.9 | 9.1093 | 540 |
| 550 | 7.5959 | 3596.7 | 9.2912 | 6.3295 | 3596.6 | 9.2070 | 5.4250 | 3596.6 | 9.1357 | 550 |
| 560 | 7.6882 | 3618.4 | 9.3174 | 6.4065 | 3618.4 | 9.2332 | 5.4910 | 3618.3 | 9.1620 | 560 |
| 570 | 7.7806 | 3640.2 | 9.3434 | 6.4835 | 3640.1 | 9.2592 | 5.5570 | 3640.0 | 9.1879 | 570 |
| 580 | 7.8730 | 3662.1 | 9.3691 | 6.5605 | 3662.0 | 9.2849 | 5.6230 | 3661.9 | 9.2137 | 580 |
| 590 | 7.9654 | 3684.0 | 9.3947 | 6.6375 | 3683.9 | 9.3105 | 5.6890 | 3683.8 | 9.2392 | 590 |
| 600 | 8.0578 | 3706.0 | 9.4200 | 6.7145 | 3705.9 | 9.3358 | 5.7550 | 3705.8 | 9.2646 | 600 |
| 610 | 8.1501 | 3728.0 | 9.4451 | 6.7915 | 3727.9 | 9.3609 | 5.8210 | 3727.9 | 9.2897 | 610 |
| 620 | 8.2425 | 3750.1 | 9.4700 | 6.8685 | 3750.1 | 9.3858 | 5.8870 | 3750.0 | 9.3146 | 620 |
| 630 | 8.3349 | 3772.3 | 9.4947 | 6.9454 | 3772.3 | 9.4105 | 5.9530 | 3772.2 | 9.3393 | 630 |
| 640 | 8.4272 | 3794.6 | 9.5193 | 7.0224 | 3794.5 | 9.4351 | 6.0190 | 3794.5 | 9.3639 | 640 |
| 650 | 8.5196 | 3816.9 | 9.5436 | 7.0994 | 3816.9 | 9.4594 | 6.0850 | 3816.8 | 9.3882 | 650 |
| 660 | 8.6120 | 3839.3 | 9.5677 | 7.1764 | 3839.3 | 9.4835 | 6.1510 | 3839.2 | 9.4123 | 660 |
| 670 | 8.7043 | 3861.8 | 9.5917 | 7.2534 | 3861.8 | 9.5075 | 6.2170 | 3861.7 | 9.4363 | 670 |
| 680 | 8.7967 | 3884.4 | 9.6155 | 7.3303 | 3884.3 | 9.5313 | 6.2829 | 3884.2 | 9.4601 | 680 |
| 690 | 8.8890 | 3907.0 | 9.6391 | 7.4073 | 3906.9 | 9.5549 | 6.3489 | 3906.9 | 9.4837 | 690 |
| 700 | 8.9814 | 3929.7 | 9.6625 | 7.4843 | 3929.6 | 9.5783 | 6.4149 | 3929.6 | 9.5071 | 700 |
| 710 | 9.0737 | 3952.4 | 9.6858 | 7.5612 | 3952.4 | 9.6016 | 6.4809 | 3952.3 | 9.5304 | 710 |
| 720 | 9.1661 | 3975.3 | 9.7089 | 7.6382 | 3975.2 | 9.6247 | 6.5469 | 3975.2 | 9.5535 | 720 |
| 730 | 9.2584 | 3998.2 | 9.7318 | 7.7152 | 3998.1 | 9.6476 | 6.6128 | 3998.1 | 9.5764 | 730 |
| 740 | 9.3508 | 4021.1 | 9.7546 | 7.7921 | 4021.1 | 9.6704 | 6.6788 | 4021.0 | 9.5992 | 740 |
| 750 | 9.4431 | 4044.2 | 9.7772 | 7.8691 | 4044.1 | 9.6931 | 6.7448 | 4044.1 | 9.6219 | 750 |
| 760 | 9.5355 | 4067.3 | 9.7997 | 7.9460 | 4067.2 | 9.7155 | 6.8107 | 4067.2 | 9.6444 | 760 |
| 770 | 9.6278 | 4090.5 | 9.8220 | 8.0230 | 4090.4 | 9.7379 | 6.8767 | 4090.4 | 9.6667 | 770 |
| 780 | 9.7201 | 4113.7 | 9.8442 | 8.1000 | 4113.7 | 9.7601 | 6.9427 | 4113.6 | 9.6889 | 780 |
| 790 | 9.8125 | 4137.0 | 9.8663 | 8.1769 | 4137.0 | 9.7821 | 7.0087 | 4137.0 | 9.7109 | 790 |
| 800 | 9.9048 | 4160.5 | 9.8882 | 8.2539 | 4160.4 | 9.8040 | 7.0746 | 4160.4 | 9.7328 | 800 |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.08 MPa ($t_{sat}$ = 93.49 °C) | | | 0.09 MPa ($t_{sat}$ = 96.69 °C) | | | 0.10 MPa ($t_{sat}$ = 99.61 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *t* (°C) | *v* | *h* | *s* | *v* | *h* | *s* | *v* | *h* | *s* | *t* (°C) |
| Sat. Liq. | 0.001 038 5 | 391.64 | 1.2328 | 0.001 040 9 | 405.13 | 1.2694 | 0.001 043 1 | 417.44 | 1.3026 | Sat. Liq. |
| Sat. Vap. | 2.0872 | 2665.2 | 7.4339 | 1.8695 | 2670.3 | 7.3942 | 1.6940 | 2674.9 | 7.3588 | Sat. Vap. |
| **0** | 0.001 000 2 | 0.04 | -0.0001 | 0.001 000 2 | 0.05 | -0.0001 | 0.001 000 2 | 0.06 | -0.0001 | **0** |
| **5** | 0.001 000 0 | 21.10 | 0.0763 | 0.001 000 0 | 21.11 | 0.0763 | 0.001 000 0 | 21.12 | 0.0763 | **5** |
| **10** | 0.001 000 3 | 42.10 | 0.1511 | 0.001 000 3 | 42.11 | 0.1511 | 0.001 000 3 | 42.12 | 0.1511 | **10** |
| **15** | 0.001 000 9 | 63.06 | 0.2245 | 0.001 000 9 | 63.07 | 0.2245 | 0.001 000 9 | 63.08 | 0.2245 | **15** |
| **20** | 0.001 001 8 | 83.99 | 0.2965 | 0.001 001 8 | 84.00 | 0.2965 | 0.001 001 8 | 84.01 | 0.2965 | **20** |
| **25** | 0.001 003 0 | 104.91 | 0.3672 | 0.001 003 0 | 104.92 | 0.3672 | 0.001 003 0 | 104.93 | 0.3672 | **25** |
| **30** | 0.001 004 4 | 125.81 | 0.4368 | 0.001 004 4 | 125.82 | 0.4368 | 0.001 004 4 | 125.83 | 0.4368 | **30** |
| **35** | 0.001 006 0 | 146.71 | 0.5051 | 0.001 006 0 | 146.72 | 0.5051 | 0.001 006 0 | 146.73 | 0.5051 | **35** |
| **40** | 0.001 007 8 | 167.61 | 0.5724 | 0.001 007 8 | 167.61 | 0.5724 | 0.001 007 8 | 167.62 | 0.5724 | **40** |
| **45** | 0.001 009 9 | 188.50 | 0.6386 | 0.001 009 9 | 188.51 | 0.6386 | 0.001 009 9 | 188.52 | 0.6386 | **45** |
| **50** | 0.001 012 1 | 209.39 | 0.7038 | 0.001 012 1 | 209.40 | 0.7038 | 0.001 012 1 | 209.41 | 0.7038 | **50** |
| **55** | 0.001 014 5 | 230.30 | 0.7679 | 0.001 014 5 | 230.30 | 0.7679 | 0.001 014 5 | 230.31 | 0.7679 | **55** |
| **60** | 0.001 017 1 | 251.20 | 0.8312 | 0.001 017 1 | 251.21 | 0.8312 | 0.001 017 1 | 251.22 | 0.8312 | **60** |
| **65** | 0.001 019 8 | 272.12 | 0.8935 | 0.001 019 8 | 272.13 | 0.8935 | 0.001 019 8 | 272.14 | 0.8935 | **65** |
| **70** | 0.001 022 7 | 293.06 | 0.9550 | 0.001 022 7 | 293.07 | 0.9550 | 0.001 022 7 | 293.07 | 0.9550 | **70** |
| **75** | 0.001 025 8 | 314.01 | 1.0156 | 0.001 025 8 | 314.02 | 1.0156 | 0.001 025 8 | 314.02 | 1.0156 | **75** |
| **80** | 0.001 029 0 | 334.97 | 1.0754 | 0.001 029 0 | 334.98 | 1.0754 | 0.001 029 0 | 334.99 | 1.0754 | **80** |
| **85** | 0.001 032 4 | 355.96 | 1.1344 | 0.001 032 4 | 355.97 | 1.1344 | 0.001 032 4 | 355.98 | 1.1344 | **85** |
| **90** | 0.001 035 9 | 376.98 | 1.1927 | 0.001 035 9 | 376.98 | 1.1926 | 0.001 035 9 | 376.99 | 1.1926 | **90** |
| **95** | 2.0964 | 2668.3 | 7.4423 | 0.001 039 6 | 398.02 | 1.2502 | 0.001 039 6 | 398.03 | 1.2502 | **95** |
| **100** | 2.1268 | 2678.5 | 7.4698 | 1.8875 | 2677.1 | 7.4126 | 1.6960 | 2675.8 | 7.3610 | **100** |
| **105** | 2.1570 | 2688.6 | 7.4968 | 1.9145 | 2687.3 | 7.4398 | 1.7205 | 2686.1 | 7.3885 | **105** |
| **110** | 2.1871 | 2698.7 | 7.5232 | 1.9414 | 2697.5 | 7.4664 | 1.7448 | 2696.3 | 7.4154 | **110** |
| **115** | 2.2171 | 2708.7 | 7.5492 | 1.9682 | 2707.6 | 7.4926 | 1.7691 | 2706.5 | 7.4417 | **115** |
| **120** | 2.2470 | 2718.7 | 7.5747 | 1.9949 | 2717.6 | 7.5183 | 1.7932 | 2716.6 | 7.4676 | **120** |
| **125** | 2.2768 | 2728.6 | 7.5999 | 2.0216 | 2727.6 | 7.5436 | 1.8173 | 2726.7 | 7.4931 | **125** |
| **130** | 2.3066 | 2738.5 | 7.6247 | 2.0481 | 2737.6 | 7.5685 | 1.8413 | 2736.7 | 7.5181 | **130** |
| **135** | 2.3363 | 2748.4 | 7.6491 | 2.0746 | 2747.6 | 7.5931 | 1.8653 | 2746.7 | 7.5428 | **135** |
| **140** | 2.3659 | 2758.3 | 7.6732 | 2.1010 | 2757.5 | 7.6173 | 1.8891 | 2756.7 | 7.5671 | **140** |
| **145** | 2.3955 | 2768.2 | 7.6969 | 2.1274 | 2767.4 | 7.6411 | 1.9130 | 2766.7 | 7.5911 | **145** |
| **150** | 2.4250 | 2778.0 | 7.7203 | 2.1538 | 2777.3 | 7.6646 | 1.9367 | 2776.6 | 7.6147 | **150** |
| **155** | 2.4545 | 2787.9 | 7.7435 | 2.1800 | 2787.2 | 7.6879 | 1.9605 | 2786.5 | 7.6380 | **155** |
| **160** | 2.4840 | 2797.7 | 7.7663 | 2.2063 | 2797.1 | 7.7108 | 1.9841 | 2796.4 | 7.6610 | **160** |
| **165** | 2.5134 | 2807.6 | 7.7889 | 2.2325 | 2806.9 | 7.7334 | 2.0078 | 2806.3 | 7.6837 | **165** |
| **170** | 2.5428 | 2817.4 | 7.8112 | 2.2587 | 2816.8 | 7.7558 | 2.0314 | 2816.2 | 7.7062 | **170** |
| **175** | 2.5721 | 2827.2 | 7.8333 | 2.2848 | 2826.7 | 7.7779 | 2.0550 | 2826.1 | 7.7283 | **175** |
| **180** | 2.6014 | 2837.1 | 7.8551 | 2.3109 | 2836.5 | 7.7998 | 2.0785 | 2836.0 | 7.7503 | **180** |
| **185** | 2.6307 | 2846.9 | 7.8767 | 2.3370 | 2846.4 | 7.8214 | 2.1021 | 2845.8 | 7.7719 | **185** |
| **190** | 2.6600 | 2856.7 | 7.8980 | 2.3631 | 2856.2 | 7.8428 | 2.1256 | 2855.7 | 7.7934 | **190** |
| **195** | 2.6892 | 2866.6 | 7.9191 | 2.3891 | 2866.1 | 7.8640 | 2.1490 | 2865.6 | 7.8146 | **195** |
| **200** | 2.7184 | 2876.4 | 7.9400 | 2.4151 | 2875.9 | 7.8849 | 2.1725 | 2875.5 | 7.8356 | **200** |
| **205** | 2.7477 | 2886.2 | 7.9607 | 2.4411 | 2885.8 | 7.9057 | 2.1959 | 2885.4 | 7.8563 | **205** |
| **210** | 2.7768 | 2896.1 | 7.9812 | 2.4671 | 2895.7 | 7.9262 | 2.2194 | 2895.2 | 7.8769 | **210** |
| **215** | 2.8060 | 2906.0 | 8.0015 | 2.4931 | 2905.5 | 7.9465 | 2.2428 | 2905.1 | 7.8973 | **215** |
| **220** | 2.8352 | 2915.8 | 8.0216 | 2.5190 | 2915.4 | 7.9667 | 2.2661 | 2915.0 | 7.9174 | **220** |
| **225** | 2.8643 | 2925.7 | 8.0415 | 2.5450 | 2925.3 | 7.9866 | 2.2895 | 2924.9 | 7.9374 | **225** |
| **230** | 2.8934 | 2935.6 | 8.0613 | 2.5709 | 2935.2 | 8.0064 | 2.3129 | 2934.8 | 7.9572 | **230** |
| **235** | 2.9225 | 2945.5 | 8.0808 | 2.5968 | 2945.1 | 8.0259 | 2.3362 | 2944.7 | 7.9768 | **235** |
| **240** | 2.9516 | 2955.4 | 8.1002 | 2.6227 | 2955.0 | 8.0454 | 2.3596 | 2954.7 | 7.9962 | **240** |
| **245** | 2.9807 | 2965.3 | 8.1194 | 2.6486 | 2964.9 | 8.0646 | 2.3829 | 2964.6 | 8.0155 | **245** |
| **250** | 3.0098 | 2975.2 | 8.1385 | 2.6745 | 2974.9 | 8.0837 | 2.4062 | 2974.5 | 8.0346 | **250** |
| **255** | 3.0389 | 2985.1 | 8.1574 | 2.7003 | 2984.8 | 8.1026 | 2.4295 | 2984.5 | 8.0535 | **255** |
| **260** | 3.0680 | 2995.1 | 8.1761 | 2.7262 | 2994.8 | 8.1213 | 2.4528 | 2994.4 | 8.0723 | **260** |
| **265** | 3.0970 | 3005.0 | 8.1947 | 2.7520 | 3004.7 | 8.1399 | 2.4761 | 3004.4 | 8.0909 | **265** |
| **270** | 3.1261 | 3015.0 | 8.2131 | 2.7779 | 3014.7 | 8.1584 | 2.4994 | 3014.4 | 8.1094 | **270** |

**UNITS**: *v* in $m^3$/kg ; *h* in kJ/kg ; *s* in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 0.08 MPa ($t_{sat}$ = 93.49 °C) | | | 0.09 MPa ($t_{sat}$ = 96.69 °C) | | | 0.10 MPa ($t_{sat}$ = 99.61 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| 275 | 3.1551 | 3025.0 | 8.2314 | 2.8037 | 3024.7 | 8.1767 | 2.5226 | 3024.4 | 8.1277 | 275 |
| 280 | 3.1841 | 3034.9 | 8.2496 | 2.8295 | 3034.7 | 8.1948 | 2.5459 | 3034.4 | 8.1458 | 280 |
| 285 | 3.2131 | 3044.9 | 8.2676 | 2.8554 | 3044.7 | 8.2128 | 2.5691 | 3044.4 | 8.1639 | 285 |
| 290 | 3.2422 | 3055.0 | 8.2854 | 2.8812 | 3054.7 | 8.2307 | 2.5924 | 3054.4 | 8.1818 | 290 |
| 295 | 3.2712 | 3065.0 | 8.3031 | 2.9070 | 3064.7 | 8.2485 | 2.6156 | 3064.5 | 8.1995 | 295 |
| 300 | 3.3002 | 3075.0 | 8.3207 | 2.9328 | 3074.8 | 8.2661 | 2.6389 | 3074.5 | 8.2171 | 300 |
| 310 | 3.3582 | 3095.2 | 8.3555 | 2.9844 | 3094.9 | 8.3009 | 2.6853 | 3094.7 | 8.2520 | 310 |
| 320 | 3.4162 | 3115.3 | 8.3899 | 3.0359 | 3115.1 | 8.3352 | 2.7318 | 3114.9 | 8.2863 | 320 |
| 330 | 3.4741 | 3135.6 | 8.4237 | 3.0875 | 3135.4 | 8.3691 | 2.7782 | 3135.1 | 8.3202 | 330 |
| 340 | 3.5320 | 3155.9 | 8.4570 | 3.1390 | 3155.7 | 8.4024 | 2.8246 | 3155.5 | 8.3536 | 340 |
| 350 | 3.5900 | 3176.2 | 8.4900 | 3.1905 | 3176.0 | 8.4354 | 2.8710 | 3175.8 | 8.3865 | 350 |
| 360 | 3.6479 | 3196.6 | 8.5225 | 3.2420 | 3196.4 | 8.4679 | 2.9173 | 3196.2 | 8.4190 | 360 |
| 370 | 3.7058 | 3217.1 | 8.5545 | 3.2935 | 3216.9 | 8.5000 | 2.9637 | 3216.7 | 8.4511 | 370 |
| 380 | 3.7637 | 3237.6 | 8.5862 | 3.3450 | 3237.4 | 8.5317 | 3.0101 | 3237.3 | 8.4828 | 380 |
| 390 | 3.8215 | 3258.2 | 8.6175 | 3.3965 | 3258.0 | 8.5629 | 3.0564 | 3257.9 | 8.5141 | 390 |
| 400 | 3.8794 | 3278.9 | 8.6484 | 3.4479 | 3278.7 | 8.5939 | 3.1027 | 3278.5 | 8.5451 | 400 |
| 410 | 3.9373 | 3299.6 | 8.6789 | 3.4994 | 3299.4 | 8.6244 | 3.1490 | 3299.3 | 8.5756 | 410 |
| 420 | 3.9951 | 3320.3 | 8.7091 | 3.5508 | 3320.2 | 8.6546 | 3.1954 | 3320.1 | 8.6059 | 420 |
| 430 | 4.0530 | 3341.2 | 8.7390 | 3.6022 | 3341.1 | 8.6845 | 3.2417 | 3340.9 | 8.6357 | 430 |
| 440 | 4.1108 | 3362.1 | 8.7685 | 3.6537 | 3362.0 | 8.7140 | 3.2879 | 3361.8 | 8.6653 | 440 |
| 450 | 4.1686 | 3383.1 | 8.7977 | 3.7051 | 3382.9 | 8.7432 | 3.3342 | 3382.8 | 8.6945 | 450 |
| 460 | 4.2264 | 3404.1 | 8.8266 | 3.7565 | 3404.0 | 8.7721 | 3.3805 | 3403.9 | 8.7234 | 460 |
| 470 | 4.2842 | 3425.2 | 8.8552 | 3.8079 | 3425.1 | 8.8007 | 3.4268 | 3425.0 | 8.7520 | 470 |
| 480 | 4.3421 | 3446.4 | 8.8835 | 3.8593 | 3446.3 | 8.8290 | 3.4731 | 3446.2 | 8.7803 | 480 |
| 490 | 4.3999 | 3467.6 | 8.9115 | 3.9107 | 3467.5 | 8.8571 | 3.5193 | 3467.4 | 8.8083 | 490 |
| 500 | 4.4577 | 3488.9 | 8.9393 | 3.9621 | 3488.8 | 8.8848 | 3.5656 | 3488.7 | 8.8361 | 500 |
| 510 | 4.5154 | 3510.3 | 8.9667 | 4.0134 | 3510.2 | 8.9123 | 3.6118 | 3510.1 | 8.8635 | 510 |
| 520 | 4.5732 | 3531.7 | 8.9939 | 4.0648 | 3531.6 | 8.9395 | 3.6581 | 3531.5 | 8.8907 | 520 |
| 530 | 4.6310 | 3553.2 | 9.0209 | 4.1162 | 3553.1 | 8.9664 | 3.7043 | 3553.0 | 8.9177 | 530 |
| 540 | 4.6888 | 3574.8 | 9.0476 | 4.1676 | 3574.7 | 8.9931 | 3.7506 | 3574.6 | 8.9444 | 540 |
| 550 | 4.7466 | 3596.5 | 9.0740 | 4.2189 | 3596.4 | 9.0196 | 3.7968 | 3596.3 | 8.9709 | 550 |
| 560 | 4.8043 | 3618.2 | 9.1002 | 4.2703 | 3618.1 | 9.0458 | 3.8430 | 3618.0 | 8.9971 | 560 |
| 570 | 4.8621 | 3640.0 | 9.1262 | 4.3216 | 3639.9 | 9.0718 | 3.8893 | 3639.8 | 9.0231 | 570 |
| 580 | 4.9199 | 3661.8 | 9.1520 | 4.3730 | 3661.7 | 9.0976 | 3.9355 | 3661.6 | 9.0489 | 580 |
| 590 | 4.9776 | 3683.7 | 9.1775 | 4.4244 | 3683.7 | 9.1231 | 3.9817 | 3683.6 | 9.0744 | 590 |
| 600 | 5.0354 | 3705.7 | 9.2029 | 4.4757 | 3705.6 | 9.1485 | 4.0279 | 3705.6 | 9.0998 | 600 |
| 610 | 5.0932 | 3727.8 | 9.2280 | 4.5271 | 3727.7 | 9.1736 | 4.0742 | 3727.6 | 9.1249 | 610 |
| 620 | 5.1509 | 3749.9 | 9.2529 | 4.5784 | 3749.8 | 9.1985 | 4.1204 | 3749.8 | 9.1498 | 620 |
| 630 | 5.2087 | 3772.1 | 9.2776 | 4.6297 | 3772.1 | 9.2232 | 4.1666 | 3772.0 | 9.1745 | 630 |
| 640 | 5.2664 | 3794.4 | 9.3022 | 4.6811 | 3794.3 | 9.2477 | 4.2128 | 3794.3 | 9.1991 | 640 |
| 650 | 5.3242 | 3816.7 | 9.3265 | 4.7324 | 3816.7 | 9.2721 | 4.2590 | 3816.6 | 9.2234 | 650 |
| 660 | 5.3819 | 3839.1 | 9.3506 | 4.7838 | 3839.1 | 9.2962 | 4.3052 | 3839.0 | 9.2476 | 660 |
| 670 | 5.4397 | 3861.6 | 9.3746 | 4.8351 | 3861.6 | 9.3202 | 4.3514 | 3861.5 | 9.2715 | 670 |
| 680 | 5.4974 | 3884.2 | 9.3984 | 4.8864 | 3884.1 | 9.3440 | 4.3976 | 3884.1 | 9.2953 | 680 |
| 690 | 5.5551 | 3906.8 | 9.4220 | 4.9377 | 3906.7 | 9.3676 | 4.4438 | 3906.7 | 9.3189 | 690 |
| 700 | 5.6129 | 3929.5 | 9.4455 | 4.9891 | 3929.4 | 9.3910 | 4.4900 | 3929.4 | 9.3424 | 700 |
| 710 | 5.6706 | 3952.3 | 9.4687 | 5.0404 | 3952.2 | 9.4143 | 4.5362 | 3952.1 | 9.3656 | 710 |
| 720 | 5.7283 | 3975.1 | 9.4918 | 5.0917 | 3975.0 | 9.4374 | 4.5824 | 3975.0 | 9.3888 | 720 |
| 730 | 5.7861 | 3998.0 | 9.5148 | 5.1430 | 3997.9 | 9.4604 | 4.6286 | 3997.9 | 9.4117 | 730 |
| 740 | 5.8438 | 4021.0 | 9.5376 | 5.1944 | 4020.9 | 9.4832 | 4.6748 | 4020.9 | 9.4345 | 740 |
| 750 | 5.9015 | 4044.0 | 9.5602 | 5.2457 | 4044.0 | 9.5058 | 4.7210 | 4043.9 | 9.4571 | 750 |
| 760 | 5.9593 | 4067.1 | 9.5827 | 5.2970 | 4067.1 | 9.5283 | 4.7672 | 4067.0 | 9.4796 | 760 |
| 770 | 6.0170 | 4090.3 | 9.6050 | 5.3483 | 4090.3 | 9.5506 | 4.8134 | 4090.2 | 9.5020 | 770 |
| 780 | 6.0747 | 4113.6 | 9.6272 | 5.3996 | 4113.5 | 9.5728 | 4.8596 | 4113.5 | 9.5241 | 780 |
| 790 | 6.1325 | 4136.9 | 9.6493 | 5.4510 | 4136.9 | 9.5949 | 4.9058 | 4136.8 | 9.5462 | 790 |
| 800 | 6.1902 | 4160.3 | 9.6712 | 5.5023 | 4160.3 | 9.6168 | 4.9520 | 4160.2 | 9.5681 | 800 |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 0.11 MPa ($t_{sat}$ = 102.29 °C) | | | 0.12 MPa ($t_{sat}$ = 104.78 °C) | | | 0.13 MPa ($t_{sat}$ = 107.11 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| Sat. Liq. | 0.001 045 3 | 428.77 | 1.3328 | 0.001 047 3 | 439.30 | 1.3608 | 0.001 049 2 | 449.13 | 1.3867 | Sat. Liq. |
| Sat. Vap. | 1.5496 | 2679.2 | 7.3268 | 1.4284 | 2683.1 | 7.2976 | 1.3254 | 2686.6 | 7.2708 | Sat. Vap. |
| 0 | 0.001 000 2 | 0.07 | -0.0001 | 0.001 000 1 | 0.08 | -0.0001 | 0.001 000 1 | 0.09 | -0.0001 | 0 |
| 5 | 0.001 000 0 | 21.13 | 0.0762 | 0.001 000 0 | 21.14 | 0.0762 | 0.001 000 0 | 21.15 | 0.0762 | 5 |
| 10 | 0.001 000 3 | 42.13 | 0.1511 | 0.001 000 3 | 42.14 | 0.1511 | 0.001 000 3 | 42.15 | 0.1511 | 10 |
| 15 | 0.001 000 9 | 63.09 | 0.2245 | 0.001 000 9 | 63.10 | 0.2245 | 0.001 000 9 | 63.11 | 0.2245 | 15 |
| 20 | 0.001 001 8 | 84.02 | 0.2965 | 0.001 001 8 | 84.03 | 0.2965 | 0.001 001 8 | 84.04 | 0.2965 | 20 |
| 25 | 0.001 003 0 | 104.94 | 0.3672 | 0.001 003 0 | 104.95 | 0.3672 | 0.001 002 9 | 104.96 | 0.3672 | 25 |
| 30 | 0.001 004 4 | 125.84 | 0.4368 | 0.001 004 4 | 125.85 | 0.4368 | 0.001 004 4 | 125.86 | 0.4368 | 30 |
| 35 | 0.001 006 0 | 146.74 | 0.5051 | 0.001 006 0 | 146.75 | 0.5051 | 0.001 006 0 | 146.76 | 0.5051 | 35 |
| 40 | 0.001 007 8 | 167.63 | 0.5724 | 0.001 007 8 | 167.64 | 0.5724 | 0.001 007 8 | 167.65 | 0.5724 | 40 |
| 45 | 0.001 009 9 | 188.52 | 0.6386 | 0.001 009 9 | 188.53 | 0.6386 | 0.001 009 9 | 188.54 | 0.6386 | 45 |
| 50 | 0.001 012 1 | 209.42 | 0.7037 | 0.001 012 1 | 209.43 | 0.7037 | 0.001 012 1 | 209.44 | 0.7037 | 50 |
| 55 | 0.001 014 5 | 230.32 | 0.7679 | 0.001 014 5 | 230.33 | 0.7679 | 0.001 014 5 | 230.34 | 0.7679 | 55 |
| 60 | 0.001 017 1 | 251.23 | 0.8312 | 0.001 017 1 | 251.24 | 0.8312 | 0.001 017 1 | 251.25 | 0.8312 | 60 |
| 65 | 0.001 019 8 | 272.15 | 0.8935 | 0.001 019 8 | 272.16 | 0.8935 | 0.001 019 8 | 272.17 | 0.8935 | 65 |
| 70 | 0.001 022 7 | 293.08 | 0.9549 | 0.001 022 7 | 293.09 | 0.9549 | 0.001 022 7 | 293.10 | 0.9549 | 70 |
| 75 | 0.001 025 8 | 314.03 | 1.0156 | 0.001 025 8 | 314.04 | 1.0155 | 0.001 025 8 | 314.05 | 1.0155 | 75 |
| 80 | 0.001 029 0 | 335.00 | 1.0754 | 0.001 029 0 | 335.01 | 1.0753 | 0.001 029 0 | 335.01 | 1.0753 | 80 |
| 85 | 0.001 032 4 | 355.99 | 1.1344 | 0.001 032 4 | 355.99 | 1.1344 | 0.001 032 4 | 356.00 | 1.1344 | 85 |
| 90 | 0.001 035 9 | 377.00 | 1.1926 | 0.001 035 9 | 377.01 | 1.1926 | 0.001 035 9 | 377.01 | 1.1926 | 90 |
| 95 | 0.001 039 6 | 398.04 | 1.2502 | 0.001 039 6 | 398.05 | 1.2502 | 0.001 039 6 | 398.05 | 1.2502 | 95 |
| 100 | 0.001 043 5 | 419.11 | 1.3070 | 0.001 043 4 | 419.11 | 1.3070 | 0.001 043 4 | 419.12 | 1.3070 | 100 |
| 105 | 1.5617 | 2684.8 | 7.3418 | 1.4293 | 2683.5 | 7.2988 | 0.001 047 4 | 440.22 | 1.3632 | 105 |
| 110 | 1.5840 | 2695.1 | 7.3689 | 1.4499 | 2693.9 | 7.3262 | 1.3364 | 2692.7 | 7.2867 | 110 |
| 115 | 1.6061 | 2705.4 | 7.3955 | 1.4703 | 2704.3 | 7.3530 | 1.3554 | 2703.1 | 7.3137 | 115 |
| 120 | 1.6282 | 2715.6 | 7.4215 | 1.4907 | 2714.5 | 7.3793 | 1.3743 | 2713.5 | 7.3402 | 120 |
| 125 | 1.6502 | 2725.7 | 7.4472 | 1.5109 | 2724.7 | 7.4051 | 1.3931 | 2723.7 | 7.3661 | 125 |
| 130 | 1.6721 | 2735.8 | 7.4724 | 1.5311 | 2734.9 | 7.4304 | 1.4118 | 2733.9 | 7.3916 | 130 |
| 135 | 1.6940 | 2745.9 | 7.4971 | 1.5512 | 2745.0 | 7.4553 | 1.4304 | 2744.1 | 7.4167 | 135 |
| 140 | 1.7157 | 2755.9 | 7.5216 | 1.5712 | 2755.1 | 7.4798 | 1.4490 | 2754.2 | 7.4413 | 140 |
| 145 | 1.7375 | 2765.9 | 7.5456 | 1.5912 | 2765.1 | 7.5040 | 1.4675 | 2764.3 | 7.4656 | 145 |
| 150 | 1.7592 | 2775.9 | 7.5693 | 1.6112 | 2775.1 | 7.5278 | 1.4859 | 2774.4 | 7.4895 | 150 |
| 155 | 1.7808 | 2785.8 | 7.5927 | 1.6311 | 2785.1 | 7.5513 | 1.5044 | 2784.4 | 7.5131 | 155 |
| 160 | 1.8024 | 2795.8 | 7.6158 | 1.6509 | 2795.1 | 7.5745 | 1.5227 | 2794.4 | 7.5363 | 160 |
| 165 | 1.8239 | 2805.7 | 7.6386 | 1.6707 | 2805.1 | 7.5973 | 1.5411 | 2804.4 | 7.5593 | 165 |
| 170 | 1.8454 | 2815.6 | 7.6611 | 1.6905 | 2815.0 | 7.6199 | 1.5593 | 2814.4 | 7.5819 | 170 |
| 175 | 1.8669 | 2825.5 | 7.6834 | 1.7102 | 2824.9 | 7.6422 | 1.5776 | 2824.4 | 7.6043 | 175 |
| 180 | 1.8884 | 2835.4 | 7.7053 | 1.7299 | 2834.9 | 7.6642 | 1.5958 | 2834.3 | 7.6264 | 180 |
| 185 | 1.9098 | 2845.3 | 7.7271 | 1.7496 | 2844.8 | 7.6860 | 1.6141 | 2844.3 | 7.6482 | 185 |
| 190 | 1.9312 | 2855.2 | 7.7485 | 1.7693 | 2854.7 | 7.7076 | 1.6322 | 2854.2 | 7.6698 | 190 |
| 195 | 1.9526 | 2865.1 | 7.7698 | 1.7889 | 2864.6 | 7.7289 | 1.6504 | 2864.1 | 7.6911 | 195 |
| 200 | 1.9740 | 2875.0 | 7.7908 | 1.8085 | 2874.5 | 7.7499 | 1.6685 | 2874.1 | 7.7122 | 200 |
| 205 | 1.9953 | 2884.9 | 7.8116 | 1.8281 | 2884.5 | 7.7708 | 1.6866 | 2884.0 | 7.7331 | 205 |
| 210 | 2.0166 | 2894.8 | 7.8322 | 1.8477 | 2894.4 | 7.7914 | 1.7047 | 2893.9 | 7.7538 | 210 |
| 215 | 2.0379 | 2904.7 | 7.8526 | 1.8672 | 2904.3 | 7.8118 | 1.7228 | 2903.9 | 7.7742 | 215 |
| 220 | 2.0592 | 2914.6 | 7.8728 | 1.8868 | 2914.2 | 7.8321 | 1.7409 | 2913.8 | 7.7945 | 220 |
| 225 | 2.0805 | 2924.5 | 7.8928 | 1.9063 | 2924.2 | 7.8521 | 1.7589 | 2923.8 | 7.8146 | 225 |
| 230 | 2.1018 | 2934.5 | 7.9126 | 1.9258 | 2934.1 | 7.8719 | 1.7770 | 2933.7 | 7.8344 | 230 |
| 235 | 2.1230 | 2944.4 | 7.9323 | 1.9453 | 2944.0 | 7.8916 | 1.7950 | 2943.7 | 7.8541 | 235 |
| 240 | 2.1442 | 2954.3 | 7.9517 | 1.9648 | 2954.0 | 7.9111 | 1.8130 | 2953.6 | 7.8736 | 240 |
| 245 | 2.1655 | 2964.3 | 7.9710 | 1.9843 | 2963.9 | 7.9304 | 1.8310 | 2963.6 | 7.8929 | 245 |
| 250 | 2.1867 | 2974.2 | 7.9901 | 2.0038 | 2973.9 | 7.9495 | 1.8490 | 2973.6 | 7.9121 | 250 |
| 255 | 2.2079 | 2984.2 | 8.0091 | 2.0232 | 2983.9 | 7.9685 | 1.8670 | 2983.5 | 7.9311 | 255 |
| 260 | 2.2291 | 2994.1 | 8.0279 | 2.0427 | 2993.8 | 7.9873 | 1.8849 | 2993.5 | 7.9499 | 260 |
| 265 | 2.2503 | 3004.1 | 8.0465 | 2.0621 | 3003.8 | 8.0059 | 1.9029 | 3003.5 | 7.9686 | 265 |
| 270 | 2.2715 | 3014.1 | 8.0650 | 2.0815 | 3013.8 | 8.0244 | 1.9209 | 3013.5 | 7.9871 | 270 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 0.11 MPa ($t_{sat}$ = 102.29 °C) | | | 0.12 MPa ($t_{sat}$ = 104.78 °C) | | | 0.13 MPa ($t_{sat}$ = 107.11 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| 275 | 2.2926 | 3024.1 | 8.0833 | 2.1010 | 3023.8 | 8.0428 | 1.9388 | 3023.6 | 8.0054 | 275 |
| 280 | 2.3138 | 3034.1 | 8.1015 | 2.1204 | 3033.9 | 8.0610 | 1.9567 | 3033.6 | 8.0237 | 280 |
| 285 | 2.3350 | 3044.2 | 8.1195 | 2.1398 | 3043.9 | 8.0790 | 1.9747 | 3043.6 | 8.0417 | 285 |
| 290 | 2.3561 | 3054.2 | 8.1374 | 2.1592 | 3053.9 | 8.0969 | 1.9926 | 3053.7 | 8.0596 | 290 |
| 295 | 2.3773 | 3064.2 | 8.1552 | 2.1786 | 3064.0 | 8.1147 | 2.0105 | 3063.7 | 8.0774 | 295 |
| 300 | 2.3984 | 3074.3 | 8.1728 | 2.1980 | 3074.1 | 8.1323 | 2.0284 | 3073.8 | 8.0951 | 300 |
| 310 | 2.4407 | 3094.5 | 8.2077 | 2.2368 | 3094.2 | 8.1672 | 2.0642 | 3094.0 | 8.1300 | 310 |
| 320 | 2.4829 | 3114.7 | 8.2421 | 2.2755 | 3114.4 | 8.2016 | 2.1000 | 3114.2 | 8.1644 | 320 |
| 330 | 2.5251 | 3134.9 | 8.2759 | 2.3142 | 3134.7 | 8.2355 | 2.1358 | 3134.5 | 8.1983 | 330 |
| 340 | 2.5673 | 3155.2 | 8.3093 | 2.3529 | 3155.0 | 8.2689 | 2.1715 | 3154.8 | 8.2318 | 340 |
| 350 | 2.6095 | 3175.6 | 8.3423 | 2.3916 | 3175.4 | 8.3019 | 2.2073 | 3175.2 | 8.2648 | 350 |
| 360 | 2.6517 | 3196.1 | 8.3748 | 2.4303 | 3195.9 | 8.3345 | 2.2430 | 3195.7 | 8.2973 | 360 |
| 370 | 2.6939 | 3216.5 | 8.4069 | 2.4690 | 3216.4 | 8.3666 | 2.2787 | 3216.2 | 8.3294 | 370 |
| 380 | 2.7360 | 3237.1 | 8.4387 | 2.5076 | 3236.9 | 8.3983 | 2.3144 | 3236.8 | 8.3612 | 380 |
| 390 | 2.7782 | 3257.7 | 8.4700 | 2.5463 | 3257.6 | 8.4296 | 2.3501 | 3257.4 | 8.3925 | 390 |
| 400 | 2.8203 | 3278.4 | 8.5009 | 2.5849 | 3278.2 | 8.4606 | 2.3858 | 3278.1 | 8.4235 | 400 |
| 410 | 2.8624 | 3299.1 | 8.5315 | 2.6236 | 3299.0 | 8.4912 | 2.4214 | 3298.8 | 8.4541 | 410 |
| 420 | 2.9045 | 3319.9 | 8.5617 | 2.6622 | 3319.8 | 8.5214 | 2.4571 | 3319.6 | 8.4843 | 420 |
| 430 | 2.9466 | 3340.8 | 8.5916 | 2.7008 | 3340.6 | 8.5513 | 2.4928 | 3340.5 | 8.5142 | 430 |
| 440 | 2.9887 | 3361.7 | 8.6211 | 2.7394 | 3361.6 | 8.5808 | 2.5284 | 3361.4 | 8.5438 | 440 |
| 450 | 3.0308 | 3382.7 | 8.6504 | 2.7780 | 3382.6 | 8.6101 | 2.5640 | 3382.4 | 8.5730 | 450 |
| 460 | 3.0729 | 3403.7 | 8.6793 | 2.8166 | 3403.6 | 8.6390 | 2.5997 | 3403.5 | 8.6019 | 460 |
| 470 | 3.1150 | 3424.9 | 8.7079 | 2.8552 | 3424.7 | 8.6676 | 2.6353 | 3424.6 | 8.6305 | 470 |
| 480 | 3.1571 | 3446.0 | 8.7362 | 2.8937 | 3445.9 | 8.6959 | 2.6709 | 3445.8 | 8.6589 | 480 |
| 490 | 3.1991 | 3467.3 | 8.7642 | 2.9323 | 3467.2 | 8.7240 | 2.7065 | 3467.1 | 8.6869 | 490 |
| 500 | 3.2412 | 3488.6 | 8.7920 | 2.9709 | 3488.5 | 8.7517 | 2.7421 | 3488.4 | 8.7147 | 500 |
| 510 | 3.2833 | 3510.0 | 8.8195 | 3.0094 | 3509.9 | 8.7792 | 2.7777 | 3509.8 | 8.7422 | 510 |
| 520 | 3.3253 | 3531.4 | 8.8467 | 3.0480 | 3531.3 | 8.8064 | 2.8133 | 3531.2 | 8.7694 | 520 |
| 530 | 3.3674 | 3553.0 | 8.8736 | 3.0865 | 3552.9 | 8.8334 | 2.8489 | 3552.8 | 8.7963 | 530 |
| 540 | 3.4094 | 3574.5 | 8.9003 | 3.1251 | 3574.4 | 8.8601 | 2.8845 | 3574.3 | 8.8231 | 540 |
| 550 | 3.4514 | 3596.2 | 8.9268 | 3.1636 | 3596.1 | 8.8866 | 2.9201 | 3596.0 | 8.8495 | 550 |
| 560 | 3.4935 | 3617.9 | 8.9530 | 3.2022 | 3617.8 | 8.9128 | 2.9557 | 3617.7 | 8.8758 | 560 |
| 570 | 3.5355 | 3639.7 | 8.9790 | 3.2407 | 3639.6 | 8.9388 | 2.9913 | 3639.5 | 8.9018 | 570 |
| 580 | 3.5775 | 3661.6 | 9.0048 | 3.2793 | 3661.5 | 8.9646 | 3.0268 | 3661.4 | 8.9276 | 580 |
| 590 | 3.6196 | 3683.5 | 9.0304 | 3.3178 | 3683.4 | 8.9901 | 3.0624 | 3683.3 | 8.9531 | 590 |
| 600 | 3.6616 | 3705.5 | 9.0557 | 3.3563 | 3705.4 | 9.0155 | 3.0980 | 3705.3 | 8.9785 | 600 |
| 610 | 3.7036 | 3727.6 | 9.0808 | 3.3948 | 3727.5 | 9.0406 | 3.1336 | 3727.4 | 9.0036 | 610 |
| 620 | 3.7456 | 3749.7 | 9.1058 | 3.4334 | 3749.6 | 9.0655 | 3.1691 | 3749.6 | 9.0285 | 620 |
| 630 | 3.7877 | 3771.9 | 9.1305 | 3.4719 | 3771.8 | 9.0903 | 3.2047 | 3771.8 | 9.0533 | 630 |
| 640 | 3.8297 | 3794.2 | 9.1550 | 3.5104 | 3794.1 | 9.1148 | 3.2403 | 3794.0 | 9.0778 | 640 |
| 650 | 3.8717 | 3816.5 | 9.1794 | 3.5489 | 3816.5 | 9.1391 | 3.2758 | 3816.4 | 9.1021 | 650 |
| 660 | 3.9137 | 3839.0 | 9.2035 | 3.5874 | 3838.9 | 9.1633 | 3.3114 | 3838.8 | 9.1263 | 660 |
| 670 | 3.9557 | 3861.4 | 9.2275 | 3.6260 | 3861.4 | 9.1873 | 3.3469 | 3861.3 | 9.1503 | 670 |
| 680 | 3.9977 | 3884.0 | 9.2513 | 3.6645 | 3883.9 | 9.2111 | 3.3825 | 3883.9 | 9.1741 | 680 |
| 690 | 4.0397 | 3906.6 | 9.2749 | 3.7030 | 3906.6 | 9.2347 | 3.4180 | 3906.5 | 9.1977 | 690 |
| 700 | 4.0817 | 3929.3 | 9.2983 | 3.7415 | 3929.3 | 9.2581 | 3.4536 | 3929.2 | 9.2211 | 700 |
| 710 | 4.1237 | 3952.1 | 9.3216 | 3.7800 | 3952.0 | 9.2814 | 3.4891 | 3952.0 | 9.2444 | 710 |
| 720 | 4.1657 | 3974.9 | 9.3447 | 3.8185 | 3974.9 | 9.3045 | 3.5247 | 3974.8 | 9.2675 | 720 |
| 730 | 4.2077 | 3997.8 | 9.3677 | 3.8570 | 3997.8 | 9.3275 | 3.5602 | 3997.7 | 9.2905 | 730 |
| 740 | 4.2497 | 4020.8 | 9.3905 | 3.8955 | 4020.8 | 9.3503 | 3.5958 | 4020.7 | 9.3133 | 740 |
| 750 | 4.2917 | 4043.9 | 9.4131 | 3.9340 | 4043.8 | 9.3729 | 3.6313 | 4043.8 | 9.3359 | 750 |
| 760 | 4.3337 | 4067.0 | 9.4356 | 3.9725 | 4066.9 | 9.3954 | 3.6668 | 4066.9 | 9.3584 | 760 |
| 770 | 4.3757 | 4090.2 | 9.4579 | 4.0110 | 4090.1 | 9.4177 | 3.7024 | 4090.1 | 9.3808 | 770 |
| 780 | 4.4177 | 4113.4 | 9.4801 | 4.0495 | 4113.4 | 9.4399 | 3.7379 | 4113.3 | 9.4030 | 780 |
| 790 | 4.4597 | 4136.8 | 9.5022 | 4.0880 | 4136.7 | 9.4620 | 3.7735 | 4136.7 | 9.4250 | 790 |
| 800 | 4.5017 | 4160.2 | 9.5241 | 4.1265 | 4160.1 | 9.4839 | 3.8090 | 4160.1 | 9.4469 | 800 |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.14 MPa ($t_{sat}$ = 109.29 °C) | | | 0.15 MPa ($t_{sat}$ = 111.35 °C) | | | 0.16 MPa ($t_{sat}$ = 113.30 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 051 0 | 458.37 | 1.4109 | 0.001 052 7 | 467.08 | 1.4335 | 0.001 054 4 | 475.34 | 1.4549 | Sat. Liq. |
| Sat. Vap. | 1.2366 | 2690.0 | 7.2460 | 1.1594 | 2693.1 | 7.2229 | 1.0914 | 2696.0 | 7.2014 | Sat. Vap. |
| 0 | 0.001 000 1 | 0.10 | -0.0001 | 0.001 000 1 | 0.11 | -0.0001 | 0.001 000 1 | 0.12 | -0.0001 | 0 |
| 5 | 0.001 000 0 | 21.16 | 0.0762 | 0.001 000 0 | 21.17 | 0.0762 | 0.001 000 0 | 21.18 | 0.0762 | 5 |
| 10 | 0.001 000 3 | 42.16 | 0.1511 | 0.001 000 3 | 42.17 | 0.1511 | 0.001 000 3 | 42.18 | 0.1511 | 10 |
| 15 | 0.001 000 9 | 63.12 | 0.2245 | 0.001 000 9 | 63.13 | 0.2244 | 0.001 000 9 | 63.14 | 0.2244 | 15 |
| 20 | 0.001 001 8 | 84.05 | 0.2965 | 0.001 001 8 | 84.06 | 0.2965 | 0.001 001 8 | 84.07 | 0.2965 | 20 |
| 25 | 0.001 002 9 | 104.97 | 0.3672 | 0.001 002 9 | 104.97 | 0.3672 | 0.001 002 9 | 104.98 | 0.3672 | 25 |
| 30 | 0.001 004 3 | 125.87 | 0.4368 | 0.001 004 3 | 125.88 | 0.4367 | 0.001 004 3 | 125.89 | 0.4367 | 30 |
| 35 | 0.001 006 0 | 146.77 | 0.5051 | 0.001 006 0 | 146.77 | 0.5051 | 0.001 006 0 | 146.78 | 0.5051 | 35 |
| 40 | 0.001 007 8 | 167.66 | 0.5724 | 0.001 007 8 | 167.67 | 0.5724 | 0.001 007 8 | 167.68 | 0.5724 | 40 |
| 45 | 0.001 009 9 | 188.55 | 0.6386 | 0.001 009 9 | 188.56 | 0.6386 | 0.001 009 8 | 188.57 | 0.6386 | 45 |
| 50 | 0.001 012 1 | 209.45 | 0.7037 | 0.001 012 1 | 209.45 | 0.7037 | 0.001 012 1 | 209.46 | 0.7037 | 50 |
| 55 | 0.001 014 5 | 230.35 | 0.7679 | 0.001 014 5 | 230.36 | 0.7679 | 0.001 014 5 | 230.36 | 0.7679 | 55 |
| 60 | 0.001 017 1 | 251.26 | 0.8312 | 0.001 017 1 | 251.26 | 0.8311 | 0.001 017 0 | 251.27 | 0.8311 | 60 |
| 65 | 0.001 019 8 | 272.17 | 0.8935 | 0.001 019 8 | 272.18 | 0.8935 | 0.001 019 8 | 272.19 | 0.8935 | 65 |
| 70 | 0.001 022 7 | 293.11 | 0.9549 | 0.001 022 7 | 293.12 | 0.9549 | 0.001 022 7 | 293.12 | 0.9549 | 70 |
| 75 | 0.001 025 8 | 314.06 | 1.0155 | 0.001 025 8 | 314.06 | 1.0155 | 0.001 025 8 | 314.07 | 1.0155 | 75 |
| 80 | 0.001 029 0 | 335.02 | 1.0753 | 0.001 029 0 | 335.03 | 1.0753 | 0.001 029 0 | 335.04 | 1.0753 | 80 |
| 85 | 0.001 032 4 | 356.01 | 1.1343 | 0.001 032 4 | 356.02 | 1.1343 | 0.001 032 4 | 356.03 | 1.1343 | 85 |
| 90 | 0.001 035 9 | 377.02 | 1.1926 | 0.001 035 9 | 377.03 | 1.1926 | 0.001 035 9 | 377.04 | 1.1926 | 90 |
| 95 | 0.001 039 6 | 398.06 | 1.2501 | 0.001 039 6 | 398.07 | 1.2501 | 0.001 039 6 | 398.08 | 1.2501 | 95 |
| 100 | 0.001 043 4 | 419.13 | 1.3070 | 0.001 043 4 | 419.14 | 1.3070 | 0.001 043 4 | 419.14 | 1.3070 | 100 |
| 105 | 0.001 047 4 | 440.23 | 1.3632 | 0.001 047 4 | 440.23 | 1.3631 | 0.001 047 4 | 440.24 | 1.3631 | 105 |
| 110 | 1.2392 | 2691.5 | 7.2499 | 0.001 051 6 | 461.37 | 1.4187 | 0.001 051 6 | 461.38 | 1.4187 | 110 |
| 115 | 1.2569 | 2702.0 | 7.2772 | 1.1715 | 2700.8 | 7.2430 | 1.0968 | 2699.7 | 7.2107 | 115 |
| 120 | 1.2745 | 2712.4 | 7.3038 | 1.1880 | 2711.3 | 7.2698 | 1.1123 | 2710.3 | 7.2378 | 120 |
| 125 | 1.2920 | 2722.7 | 7.3300 | 1.2045 | 2721.7 | 7.2961 | 1.1278 | 2720.7 | 7.2643 | 125 |
| 130 | 1.3095 | 2733.0 | 7.3556 | 1.2208 | 2732.1 | 7.3219 | 1.1432 | 2731.1 | 7.2902 | 130 |
| 135 | 1.3268 | 2743.2 | 7.3808 | 1.2371 | 2742.3 | 7.3472 | 1.1586 | 2741.5 | 7.3157 | 135 |
| 140 | 1.3442 | 2753.4 | 7.4055 | 1.2533 | 2752.6 | 7.3721 | 1.1738 | 2751.7 | 7.3407 | 140 |
| 145 | 1.3614 | 2763.5 | 7.4299 | 1.2695 | 2762.7 | 7.3966 | 1.1890 | 2762.0 | 7.3653 | 145 |
| 150 | 1.3786 | 2773.6 | 7.4539 | 1.2856 | 2772.9 | 7.4207 | 1.2042 | 2772.1 | 7.3895 | 150 |
| 155 | 1.3957 | 2783.7 | 7.4776 | 1.3016 | 2783.0 | 7.4445 | 1.2193 | 2782.3 | 7.4134 | 155 |
| 160 | 1.4129 | 2793.8 | 7.5009 | 1.3176 | 2793.1 | 7.4679 | 1.2343 | 2792.4 | 7.4369 | 160 |
| 165 | 1.4299 | 2803.8 | 7.5239 | 1.3336 | 2803.1 | 7.4910 | 1.2493 | 2802.5 | 7.4600 | 165 |
| 170 | 1.4470 | 2813.8 | 7.5467 | 1.3495 | 2813.2 | 7.5138 | 1.2643 | 2812.6 | 7.4829 | 170 |
| 175 | 1.4639 | 2823.8 | 7.5691 | 1.3654 | 2823.2 | 7.5362 | 1.2792 | 2822.6 | 7.5054 | 175 |
| 180 | 1.4809 | 2833.8 | 7.5912 | 1.3813 | 2833.2 | 7.5584 | 1.2941 | 2832.6 | 7.5277 | 180 |
| 185 | 1.4979 | 2843.7 | 7.6131 | 1.3971 | 2843.2 | 7.5804 | 1.3090 | 2842.7 | 7.5497 | 185 |
| 190 | 1.5148 | 2853.7 | 7.6347 | 1.4130 | 2853.2 | 7.6021 | 1.3239 | 2852.7 | 7.5714 | 190 |
| 195 | 1.5317 | 2863.7 | 7.6561 | 1.4288 | 2863.2 | 7.6235 | 1.3387 | 2862.7 | 7.5929 | 195 |
| 200 | 1.5485 | 2873.6 | 7.6773 | 1.4445 | 2873.1 | 7.6447 | 1.3535 | 2872.7 | 7.6141 | 200 |
| 205 | 1.5654 | 2883.6 | 7.6982 | 1.4603 | 2883.1 | 7.6657 | 1.3683 | 2882.7 | 7.6351 | 205 |
| 210 | 1.5822 | 2893.5 | 7.7189 | 1.4760 | 2893.1 | 7.6864 | 1.3831 | 2892.6 | 7.6559 | 210 |
| 215 | 1.5990 | 2903.5 | 7.7394 | 1.4917 | 2903.1 | 7.7069 | 1.3978 | 2902.6 | 7.6765 | 215 |
| 220 | 1.6158 | 2913.4 | 7.7597 | 1.5074 | 2913.0 | 7.7272 | 1.4126 | 2912.6 | 7.6968 | 220 |
| 225 | 1.6326 | 2923.4 | 7.7798 | 1.5231 | 2923.0 | 7.7474 | 1.4273 | 2922.6 | 7.7170 | 225 |
| 230 | 1.6494 | 2933.3 | 7.7997 | 1.5388 | 2933.0 | 7.7673 | 1.4420 | 2932.6 | 7.7369 | 230 |
| 235 | 1.6661 | 2943.3 | 7.8194 | 1.5544 | 2942.9 | 7.7870 | 1.4567 | 2942.6 | 7.7567 | 235 |
| 240 | 1.6829 | 2953.3 | 7.8389 | 1.5701 | 2952.9 | 7.8066 | 1.4714 | 2952.6 | 7.7763 | 240 |
| 245 | 1.6996 | 2963.2 | 7.8582 | 1.5857 | 2962.9 | 7.8259 | 1.4861 | 2962.6 | 7.7956 | 245 |
| 250 | 1.7163 | 2973.2 | 7.8774 | 1.6013 | 2972.9 | 7.8451 | 1.5007 | 2972.6 | 7.8149 | 250 |
| 255 | 1.7330 | 2983.2 | 7.8964 | 1.6170 | 2982.9 | 7.8641 | 1.5154 | 2982.6 | 7.8339 | 255 |
| 260 | 1.7497 | 2993.2 | 7.9153 | 1.6326 | 2992.9 | 7.8830 | 1.5300 | 2992.6 | 7.8528 | 260 |
| 265 | 1.7664 | 3003.2 | 7.9340 | 1.6482 | 3002.9 | 7.9017 | 1.5447 | 3002.6 | 7.8715 | 265 |
| 270 | 1.7831 | 3013.2 | 7.9525 | 1.6637 | 3013.0 | 7.9202 | 1.5593 | 3012.7 | 7.8901 | 270 |

**UNITS:** $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 0.14 MPa ($t_{sat}$ = 109.29 °C) | | | 0.15 MPa ($t_{sat}$ = 111.35 °C) | | | 0.16 MPa ($t_{sat}$ = 113.30 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| 275 | 1.7998 | 3023.3 | 7.9709 | 1.6793 | 3023.0 | 7.9386 | 1.5739 | 3022.7 | 7.9085 | 275 |
| 280 | 1.8165 | 3033.3 | 7.9891 | 1.6949 | 3033.0 | 7.9569 | 1.5885 | 3032.8 | 7.9267 | 280 |
| 285 | 1.8331 | 3043.4 | 8.0072 | 1.7105 | 3043.1 | 7.9750 | 1.6031 | 3042.8 | 7.9448 | 285 |
| 290 | 1.8498 | 3053.4 | 8.0251 | 1.7260 | 3053.2 | 7.9929 | 1.6177 | 3052.9 | 7.9628 | 290 |
| 295 | 1.8664 | 3063.5 | 8.0429 | 1.7416 | 3063.2 | 8.0107 | 1.6323 | 3063.0 | 7.9806 | 295 |
| 300 | 1.8831 | 3073.6 | 8.0606 | 1.7571 | 3073.3 | 8.0284 | 1.6469 | 3073.1 | 7.9983 | 300 |
| 310 | 1.9164 | 3093.8 | 8.0955 | 1.7882 | 3093.5 | 8.0634 | 1.6760 | 3093.3 | 8.0333 | 310 |
| 320 | 1.9496 | 3114.0 | 8.1299 | 1.8192 | 3113.8 | 8.0978 | 1.7052 | 3113.6 | 8.0677 | 320 |
| 330 | 1.9828 | 3134.3 | 8.1639 | 1.8503 | 3134.1 | 8.1318 | 1.7343 | 3133.9 | 8.1017 | 330 |
| 340 | 2.0161 | 3154.6 | 8.1973 | 1.8813 | 3154.4 | 8.1652 | 1.7634 | 3154.2 | 8.1352 | 340 |
| 350 | 2.0493 | 3175.0 | 8.2303 | 1.9123 | 3174.9 | 8.1983 | 1.7925 | 3174.7 | 8.1682 | 350 |
| 360 | 2.0824 | 3195.5 | 8.2629 | 1.9433 | 3195.3 | 8.2308 | 1.8215 | 3195.1 | 8.2008 | 360 |
| 370 | 2.1156 | 3216.0 | 8.2950 | 1.9743 | 3215.8 | 8.2630 | 1.8506 | 3215.7 | 8.2330 | 370 |
| 380 | 2.1488 | 3236.6 | 8.3268 | 2.0052 | 3236.4 | 8.2947 | 1.8796 | 3236.3 | 8.2648 | 380 |
| 390 | 2.1819 | 3257.2 | 8.3581 | 2.0362 | 3257.1 | 8.3261 | 1.9087 | 3256.9 | 8.2961 | 390 |
| 400 | 2.2151 | 3277.9 | 8.3891 | 2.0671 | 3277.8 | 8.3571 | 1.9377 | 3277.6 | 8.3271 | 400 |
| 410 | 2.2482 | 3298.7 | 8.4197 | 2.0981 | 3298.5 | 8.3877 | 1.9667 | 3298.4 | 8.3577 | 410 |
| 420 | 2.2813 | 3319.5 | 8.4499 | 2.1290 | 3319.3 | 8.4180 | 1.9957 | 3319.2 | 8.3880 | 420 |
| 430 | 2.3144 | 3340.4 | 8.4798 | 2.1599 | 3340.2 | 8.4479 | 2.0247 | 3340.1 | 8.4179 | 430 |
| 440 | 2.3476 | 3361.3 | 8.5094 | 2.1908 | 3361.2 | 8.4774 | 2.0537 | 3361.0 | 8.4475 | 440 |
| 450 | 2.3807 | 3382.3 | 8.5387 | 2.2217 | 3382.2 | 8.5067 | 2.0827 | 3382.0 | 8.4768 | 450 |
| 460 | 2.4138 | 3403.4 | 8.5676 | 2.2526 | 3403.2 | 8.5356 | 2.1116 | 3403.1 | 8.5057 | 460 |
| 470 | 2.4468 | 3424.5 | 8.5962 | 2.2835 | 3424.4 | 8.5643 | 2.1406 | 3424.3 | 8.5344 | 470 |
| 480 | 2.4799 | 3445.7 | 8.6245 | 2.3144 | 3445.6 | 8.5926 | 2.1696 | 3445.5 | 8.5627 | 480 |
| 490 | 2.5130 | 3467.0 | 8.6526 | 2.3453 | 3466.8 | 8.6206 | 2.1985 | 3466.7 | 8.5907 | 490 |
| 500 | 2.5461 | 3488.3 | 8.6804 | 2.3762 | 3488.2 | 8.6484 | 2.2275 | 3488.1 | 8.6185 | 500 |
| 510 | 2.5791 | 3509.7 | 8.7079 | 2.4070 | 3509.6 | 8.6759 | 2.2564 | 3509.5 | 8.6460 | 510 |
| 520 | 2.6122 | 3531.1 | 8.7351 | 2.4379 | 3531.0 | 8.7031 | 2.2854 | 3530.9 | 8.6733 | 520 |
| 530 | 2.6453 | 3552.7 | 8.7621 | 2.4687 | 3552.6 | 8.7301 | 2.3143 | 3552.5 | 8.7002 | 530 |
| 540 | 2.6783 | 3574.3 | 8.7888 | 2.4996 | 3574.2 | 8.7568 | 2.3432 | 3574.1 | 8.7270 | 540 |
| 550 | 2.7114 | 3595.9 | 8.8153 | 2.5305 | 3595.8 | 8.7833 | 2.3722 | 3595.7 | 8.7535 | 550 |
| 560 | 2.7444 | 3617.6 | 8.8415 | 2.5613 | 3617.6 | 8.8096 | 2.4011 | 3617.5 | 8.7797 | 560 |
| 570 | 2.7775 | 3639.4 | 8.8675 | 2.5922 | 3639.4 | 8.8356 | 2.4300 | 3639.3 | 8.8057 | 570 |
| 580 | 2.8105 | 3661.3 | 8.8933 | 2.6230 | 3661.2 | 8.8614 | 2.4589 | 3661.2 | 8.8315 | 580 |
| 590 | 2.8435 | 3683.3 | 8.9188 | 2.6538 | 3683.2 | 8.8869 | 2.4879 | 3683.1 | 8.8571 | 590 |
| 600 | 2.8766 | 3705.3 | 8.9442 | 2.6847 | 3705.2 | 8.9123 | 2.5168 | 3705.1 | 8.8824 | 600 |
| 610 | 2.9096 | 3727.3 | 8.9693 | 2.7155 | 3727.3 | 8.9374 | 2.5457 | 3727.2 | 8.9076 | 610 |
| 620 | 2.9426 | 3749.5 | 8.9943 | 2.7463 | 3749.4 | 8.9624 | 2.5746 | 3749.3 | 8.9325 | 620 |
| 630 | 2.9757 | 3771.7 | 9.0190 | 2.7772 | 3771.6 | 8.9871 | 2.6035 | 3771.6 | 8.9573 | 630 |
| 640 | 3.0087 | 3794.0 | 9.0435 | 2.8080 | 3793.9 | 9.0116 | 2.6324 | 3793.8 | 8.9818 | 640 |
| 650 | 3.0417 | 3816.3 | 9.0679 | 2.8388 | 3816.3 | 9.0360 | 2.6613 | 3816.2 | 9.0061 | 650 |
| 660 | 3.0747 | 3838.8 | 9.0920 | 2.8696 | 3838.7 | 9.0602 | 2.6902 | 3838.6 | 9.0303 | 660 |
| 670 | 3.1078 | 3861.2 | 9.1160 | 2.9005 | 3861.2 | 9.0841 | 2.7191 | 3861.1 | 9.0543 | 670 |
| 680 | 3.1408 | 3883.8 | 9.1398 | 2.9313 | 3883.8 | 9.1079 | 2.7480 | 3883.7 | 9.0781 | 680 |
| 690 | 3.1738 | 3906.4 | 9.1634 | 2.9621 | 3906.4 | 9.1316 | 2.7769 | 3906.3 | 9.1017 | 690 |
| 700 | 3.2068 | 3929.1 | 9.1869 | 2.9929 | 3929.1 | 9.1550 | 2.8058 | 3929.0 | 9.1252 | 700 |
| 710 | 3.2398 | 3951.9 | 9.2102 | 3.0237 | 3951.9 | 9.1783 | 2.8347 | 3951.8 | 9.1485 | 710 |
| 720 | 3.2728 | 3974.8 | 9.2333 | 3.0546 | 3974.7 | 9.2014 | 2.8636 | 3974.7 | 9.1716 | 720 |
| 730 | 3.3058 | 3997.7 | 9.2562 | 3.0854 | 3997.6 | 9.2244 | 2.8925 | 3997.6 | 9.1945 | 730 |
| 740 | 3.3388 | 4020.7 | 9.2790 | 3.1162 | 4020.6 | 9.2472 | 2.9213 | 4020.6 | 9.2173 | 740 |
| 750 | 3.3718 | 4043.7 | 9.3017 | 3.1470 | 4043.7 | 9.2698 | 2.9502 | 4043.6 | 9.2400 | 750 |
| 760 | 3.4048 | 4066.8 | 9.3242 | 3.1778 | 4066.8 | 9.2923 | 2.9791 | 4066.7 | 9.2625 | 760 |
| 770 | 3.4379 | 4090.0 | 9.3465 | 3.2086 | 4090.0 | 9.3146 | 3.0080 | 4089.9 | 9.2848 | 770 |
| 780 | 3.4709 | 4113.3 | 9.3687 | 3.2394 | 4113.2 | 9.3368 | 3.0369 | 4113.2 | 9.3070 | 780 |
| 790 | 3.5039 | 4136.6 | 9.3908 | 3.2702 | 4136.6 | 9.3589 | 3.0658 | 4136.5 | 9.3291 | 790 |
| 800 | 3.5369 | 4160.0 | 9.4127 | 3.3010 | 4160.0 | 9.3808 | 3.0946 | 4160.0 | 9.3510 | 800 |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 0.18 MPa ($t_{sat}$ = 116.91 °C) | | | 0.20 MPa ($t_{sat}$ = 120.21 °C) | | | 0.22 MPa ($t_{sat}$ = 123.25 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| Sat. Liq. | 0.001 057 6 | 490.67 | 1.4944 | 0.001 060 5 | 504.68 | 1.5301 | 0.001 063 3 | 517.62 | 1.5628 | Sat. Liq |
| Sat. Vap. | 0.977 53 | 2701.4 | 7.1620 | 0.885 74 | 2706.2 | 7.1269 | 0.810 12 | 2710.6 | 7.0951 | Sat. Vap |
| 0 | 0.001 000 1 | 0.14 | -0.0001 | 0.001 000 1 | 0.16 | -0.0001 | 0.001 000 1 | 0.18 | -0.0001 | 0 |
| 5 | 0.001 000 0 | 21.20 | 0.0762 | 0.001 000 0 | 21.22 | 0.0762 | 0.001 000 0 | 21.24 | 0.0762 | 5 |
| 10 | 0.001 000 3 | 42.20 | 0.1511 | 0.001 000 3 | 42.21 | 0.1511 | 0.001 000 2 | 42.23 | 0.1511 | 10 |
| 15 | 0.001 000 9 | 63.15 | 0.2244 | 0.001 000 9 | 63.17 | 0.2244 | 0.001 000 8 | 63.19 | 0.2244 | 15 |
| 20 | 0.001 001 8 | 84.09 | 0.2965 | 0.001 001 8 | 84.11 | 0.2965 | 0.001 001 7 | 84.12 | 0.2965 | 20 |
| 25 | 0.001 002 9 | 105.00 | 0.3672 | 0.001 002 9 | 105.02 | 0.3672 | 0.001 002 9 | 105.04 | 0.3672 | 25 |
| 30 | 0.001 004 3 | 125.91 | 0.4367 | 0.001 004 3 | 125.92 | 0.4367 | 0.001 004 3 | 125.94 | 0.4367 | 30 |
| 35 | 0.001 006 0 | 146.80 | 0.5051 | 0.001 006 0 | 146.82 | 0.5051 | 0.001 005 9 | 146.84 | 0.5051 | 35 |
| 40 | 0.001 007 8 | 167.69 | 0.5724 | 0.001 007 8 | 167.71 | 0.5724 | 0.001 007 8 | 167.73 | 0.5723 | 40 |
| 45 | 0.001 009 8 | 188.59 | 0.6386 | 0.001 009 8 | 188.60 | 0.6385 | 0.001 009 8 | 188.62 | 0.6385 | 45 |
| 50 | 0.001 012 1 | 209.48 | 0.7037 | 0.001 012 1 | 209.50 | 0.7037 | 0.001 012 0 | 209.52 | 0.7037 | 50 |
| 55 | 0.001 014 5 | 230.38 | 0.7679 | 0.001 014 5 | 230.40 | 0.7679 | 0.001 014 4 | 230.41 | 0.7679 | 55 |
| 60 | 0.001 017 0 | 251.29 | 0.8311 | 0.001 017 0 | 251.31 | 0.8311 | 0.001 017 0 | 251.32 | 0.8311 | 60 |
| 65 | 0.001 019 8 | 272.21 | 0.8935 | 0.001 019 8 | 272.22 | 0.8934 | 0.001 019 8 | 272.24 | 0.8934 | 65 |
| 70 | 0.001 022 7 | 293.14 | 0.9549 | 0.001 022 7 | 293.16 | 0.9549 | 0.001 022 7 | 293.17 | 0.9549 | 70 |
| 75 | 0.001 025 8 | 314.09 | 1.0155 | 0.001 025 7 | 314.10 | 1.0155 | 0.001 025 7 | 314.12 | 1.0155 | 75 |
| 80 | 0.001 029 0 | 335.05 | 1.0753 | 0.001 029 0 | 335.07 | 1.0753 | 0.001 029 0 | 335.09 | 1.0753 | 80 |
| 85 | 0.001 032 4 | 356.04 | 1.1343 | 0.001 032 3 | 356.06 | 1.1343 | 0.001 032 3 | 356.07 | 1.1343 | 85 |
| 90 | 0.001 035 9 | 377.05 | 1.1926 | 0.001 035 9 | 377.07 | 1.1926 | 0.001 035 9 | 377.08 | 1.1925 | 90 |
| 95 | 0.001 039 6 | 398.09 | 1.2501 | 0.001 039 6 | 398.11 | 1.2501 | 0.001 039 6 | 398.12 | 1.2501 | 95 |
| 100 | 0.001 043 4 | 419.16 | 1.3070 | 0.001 043 4 | 419.17 | 1.3069 | 0.001 043 4 | 419.19 | 1.3069 | 100 |
| 105 | 0.001 047 4 | 440.26 | 1.3631 | 0.001 047 4 | 440.27 | 1.3631 | 0.001 047 4 | 440.29 | 1.3631 | 105 |
| 110 | 0.001 051 6 | 461.39 | 1.4186 | 0.001 051 6 | 461.40 | 1.4186 | 0.001 051 5 | 461.42 | 1.4186 | 110 |
| 115 | 0.001 055 9 | 482.56 | 1.4735 | 0.001 055 9 | 482.57 | 1.4735 | 0.001 055 8 | 482.59 | 1.4735 | 115 |
| 120 | 0.986 18 | 2708.0 | 7.1790 | 0.001 060 3 | 503.79 | 1.5278 | 0.001 060 3 | 503.80 | 1.5278 | 120 |
| 125 | 1.0001 | 2718.7 | 7.2058 | 0.897 86 | 2716.6 | 7.1530 | 0.814 18 | 2714.4 | 7.1047 | 125 |
| 130 | 1.0139 | 2729.2 | 7.2321 | 0.910 41 | 2727.3 | 7.1796 | 0.825 71 | 2725.3 | 7.1317 | 130 |
| 135 | 1.0276 | 2739.7 | 7.2579 | 0.922 88 | 2737.8 | 7.2057 | 0.837 15 | 2736.0 | 7.1581 | 135 |
| 140 | 1.0413 | 2750.0 | 7.2831 | 0.935 28 | 2748.3 | 7.2312 | 0.848 52 | 2746.6 | 7.1839 | 140 |
| 145 | 1.0549 | 2760.3 | 7.3080 | 0.947 62 | 2758.7 | 7.2563 | 0.859 81 | 2757.1 | 7.2092 | 145 |
| 150 | 1.0685 | 2770.6 | 7.3324 | 0.959 89 | 2769.1 | 7.2809 | 0.871 05 | 2767.5 | 7.2341 | 150 |
| 155 | 1.0820 | 2780.8 | 7.3564 | 0.972 12 | 2779.4 | 7.3051 | 0.882 24 | 2777.9 | 7.2585 | 155 |
| 160 | 1.0954 | 2791.0 | 7.3801 | 0.984 30 | 2789.7 | 7.3290 | 0.893 38 | 2788.3 | 7.2825 | 160 |
| 165 | 1.1088 | 2801.2 | 7.4034 | 0.996 44 | 2799.9 | 7.3524 | 0.904 47 | 2798.6 | 7.3061 | 165 |
| 170 | 1.1222 | 2811.3 | 7.4264 | 1.0085 | 2810.1 | 7.3756 | 0.915 53 | 2808.8 | 7.3294 | 170 |
| 175 | 1.1356 | 2821.4 | 7.4491 | 1.0206 | 2820.3 | 7.3984 | 0.926 55 | 2819.1 | 7.3524 | 175 |
| 180 | 1.1489 | 2831.5 | 7.4714 | 1.0326 | 2830.4 | 7.4209 | 0.937 55 | 2829.3 | 7.3750 | 180 |
| 185 | 1.1622 | 2841.6 | 7.4935 | 1.0447 | 2840.5 | 7.4431 | 0.948 51 | 2839.4 | 7.3973 | 185 |
| 190 | 1.1754 | 2851.7 | 7.5154 | 1.0566 | 2850.6 | 7.4650 | 0.959 44 | 2849.6 | 7.4193 | 190 |
| 195 | 1.1886 | 2861.7 | 7.5369 | 1.0686 | 2860.7 | 7.4867 | 0.970 35 | 2859.7 | 7.4411 | 195 |
| 200 | 1.2019 | 2871.7 | 7.5583 | 1.0805 | 2870.8 | 7.5081 | 0.981 23 | 2869.8 | 7.4626 | 200 |
| 205 | 1.2151 | 2881.8 | 7.5793 | 1.0924 | 2880.8 | 7.5293 | 0.992 10 | 2879.9 | 7.4838 | 205 |
| 210 | 1.2282 | 2891.8 | 7.6002 | 1.1043 | 2890.9 | 7.5502 | 1.0029 | 2890.0 | 7.5048 | 210 |
| 215 | 1.2414 | 2901.8 | 7.6208 | 1.1162 | 2901.0 | 7.5709 | 1.0138 | 2900.1 | 7.5256 | 215 |
| 220 | 1.2545 | 2911.8 | 7.6412 | 1.1281 | 2911.0 | 7.5914 | 1.0246 | 2910.2 | 7.5461 | 220 |
| 225 | 1.2676 | 2921.8 | 7.6614 | 1.1399 | 2921.0 | 7.6116 | 1.0354 | 2920.3 | 7.5665 | 225 |
| 230 | 1.2807 | 2931.8 | 7.6814 | 1.1517 | 2931.1 | 7.6317 | 1.0462 | 2930.3 | 7.5866 | 230 |
| 235 | 1.2938 | 2941.9 | 7.7012 | 1.1635 | 2941.1 | 7.6515 | 1.0569 | 2940.4 | 7.6065 | 235 |
| 240 | 1.3069 | 2951.9 | 7.7209 | 1.1753 | 2951.2 | 7.6712 | 1.0677 | 2950.5 | 7.6262 | 240 |
| 245 | 1.3200 | 2961.9 | 7.7403 | 1.1871 | 2961.2 | 7.6907 | 1.0784 | 2960.5 | 7.6457 | 245 |
| 250 | 1.3331 | 2971.9 | 7.7596 | 1.1989 | 2971.3 | 7.7100 | 1.0892 | 2970.6 | 7.6651 | 250 |
| 255 | 1.3461 | 2982.0 | 7.7786 | 1.2107 | 2981.3 | 7.7291 | 1.0999 | 2980.7 | 7.6842 | 255 |
| 260 | 1.3591 | 2992.0 | 7.7976 | 1.2224 | 2991.4 | 7.7481 | 1.1106 | 2990.7 | 7.7032 | 260 |
| 265 | 1.3722 | 3002.0 | 7.8163 | 1.2342 | 3001.4 | 7.7669 | 1.1213 | 3000.8 | 7.7220 | 265 |
| 270 | 1.3852 | 3012.1 | 7.8349 | 1.2459 | 3011.5 | 7.7855 | 1.1320 | 3010.9 | 7.7407 | 270 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.18 MPa ($t_{sat}$ = 116.91 °C) | | | 0.20 MPa ($t_{sat}$ = 120.21 °C) | | | 0.22 MPa ($t_{sat}$ = 123.25 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 1.3982 | 3022.1 | 7.8533 | 1.2577 | 3021.6 | 7.8039 | 1.1427 | 3021.0 | 7.7592 | 275 |
| 280 | 1.4112 | 3032.2 | 7.8716 | 1.2694 | 3031.7 | 7.8223 | 1.1533 | 3031.1 | 7.7775 | 280 |
| 285 | 1.4242 | 3042.3 | 7.8898 | 1.2811 | 3041.8 | 7.8404 | 1.1640 | 3041.2 | 7.7957 | 285 |
| 290 | 1.4372 | 3052.4 | 7.9078 | 1.2928 | 3051.9 | 7.8584 | 1.1747 | 3051.3 | 7.8138 | 290 |
| 295 | 1.4502 | 3062.5 | 7.9256 | 1.3045 | 3062.0 | 7.8763 | 1.1853 | 3061.5 | 7.8317 | 295 |
| 300 | 1.4632 | 3072.6 | 7.9433 | 1.3162 | 3072.1 | 7.8940 | 1.1960 | 3071.6 | 7.8494 | 300 |
| 310 | 1.4891 | 3092.8 | 7.9783 | 1.3396 | 3092.4 | 7.9291 | 1.2173 | 3091.9 | 7.8845 | 310 |
| 320 | 1.5151 | 3113.1 | 8.0128 | 1.3630 | 3112.7 | 7.9636 | 1.2385 | 3112.2 | 7.9191 | 320 |
| 330 | 1.5410 | 3133.5 | 8.0468 | 1.3863 | 3133.0 | 7.9977 | 1.2598 | 3132.6 | 7.9532 | 330 |
| 340 | 1.5669 | 3153.8 | 8.0804 | 1.4097 | 3153.4 | 8.0312 | 1.2810 | 3153.0 | 7.9868 | 340 |
| 350 | 1.5927 | 3174.3 | 8.1134 | 1.4330 | 3173.9 | 8.0643 | 1.3022 | 3173.5 | 8.0199 | 350 |
| 360 | 1.6186 | 3194.8 | 8.1460 | 1.4563 | 3194.4 | 8.0970 | 1.3234 | 3194.0 | 8.0526 | 360 |
| 370 | 1.6445 | 3215.3 | 8.1782 | 1.4795 | 3215.0 | 8.1292 | 1.3446 | 3214.6 | 8.0848 | 370 |
| 380 | 1.6703 | 3235.9 | 8.2100 | 1.5028 | 3235.6 | 8.1610 | 1.3658 | 3235.2 | 8.1166 | 380 |
| 390 | 1.6961 | 3256.6 | 8.2414 | 1.5261 | 3256.3 | 8.1924 | 1.3870 | 3255.9 | 8.1481 | 390 |
| 400 | 1.7219 | 3277.3 | 8.2724 | 1.5493 | 3277.0 | 8.2235 | 1.4081 | 3276.7 | 8.1791 | 400 |
| 410 | 1.7477 | 3298.1 | 8.3031 | 1.5726 | 3297.8 | 8.2541 | 1.4293 | 3297.5 | 8.2098 | 410 |
| 420 | 1.7735 | 3318.9 | 8.3333 | 1.5958 | 3318.6 | 8.2844 | 1.4504 | 3318.3 | 8.2401 | 420 |
| 430 | 1.7993 | 3339.8 | 8.3633 | 1.6190 | 3339.5 | 8.3144 | 1.4715 | 3339.3 | 8.2701 | 430 |
| 440 | 1.8251 | 3360.8 | 8.3929 | 1.6423 | 3360.5 | 8.3440 | 1.4927 | 3360.2 | 8.2997 | 440 |
| 450 | 1.8509 | 3381.8 | 8.4221 | 1.6655 | 3381.5 | 8.3733 | 1.5138 | 3381.3 | 8.3290 | 450 |
| 460 | 1.8767 | 3402.9 | 8.4511 | 1.6887 | 3402.6 | 8.4022 | 1.5349 | 3402.4 | 8.3580 | 460 |
| 470 | 1.9024 | 3424.0 | 8.4798 | 1.7119 | 3423.8 | 8.4309 | 1.5560 | 3423.5 | 8.3867 | 470 |
| 480 | 1.9282 | 3445.2 | 8.5081 | 1.7351 | 3445.0 | 8.4593 | 1.5771 | 3444.8 | 8.4150 | 480 |
| 490 | 1.9539 | 3466.5 | 8.5362 | 1.7583 | 3466.3 | 8.4873 | 1.5982 | 3466.1 | 8.4431 | 490 |
| 500 | 1.9797 | 3487.9 | 8.5640 | 1.7814 | 3487.6 | 8.5151 | 1.6192 | 3487.4 | 8.4709 | 500 |
| 510 | 2.0054 | 3509.3 | 8.5915 | 1.8046 | 3509.1 | 8.5426 | 1.6403 | 3508.8 | 8.4985 | 510 |
| 520 | 2.0312 | 3530.7 | 8.6187 | 1.8278 | 3530.5 | 8.5699 | 1.6614 | 3530.3 | 8.5257 | 520 |
| 530 | 2.0569 | 3552.3 | 8.6457 | 1.8510 | 3552.1 | 8.5969 | 1.6825 | 3551.9 | 8.5527 | 530 |
| 540 | 2.0826 | 3573.9 | 8.6724 | 1.8741 | 3573.7 | 8.6236 | 1.7035 | 3573.5 | 8.5795 | 540 |
| 550 | 2.1083 | 3595.6 | 8.6989 | 1.8973 | 3595.4 | 8.6501 | 1.7246 | 3595.2 | 8.6060 | 550 |
| 560 | 2.1341 | 3617.3 | 8.7252 | 1.9204 | 3617.1 | 8.6764 | 1.7457 | 3616.9 | 8.6323 | 560 |
| 570 | 2.1598 | 3639.1 | 8.7512 | 1.9436 | 3638.9 | 8.7024 | 1.7667 | 3638.8 | 8.6583 | 570 |
| 580 | 2.1855 | 3661.0 | 8.7770 | 1.9667 | 3660.8 | 8.7282 | 1.7878 | 3660.7 | 8.6841 | 580 |
| 590 | 2.2112 | 3682.9 | 8.8026 | 1.9899 | 3682.8 | 8.7538 | 1.8088 | 3682.6 | 8.7097 | 590 |
| 600 | 2.2369 | 3704.9 | 8.8279 | 2.0130 | 3704.8 | 8.7792 | 1.8299 | 3704.6 | 8.7351 | 600 |
| 610 | 2.2626 | 3727.0 | 8.8531 | 2.0362 | 3726.9 | 8.8043 | 1.8509 | 3726.7 | 8.7602 | 610 |
| 620 | 2.2883 | 3749.2 | 8.8780 | 2.0593 | 3749.0 | 8.8293 | 1.8720 | 3748.9 | 8.7852 | 620 |
| 630 | 2.3140 | 3771.4 | 8.9028 | 2.0825 | 3771.3 | 8.8540 | 1.8930 | 3771.1 | 8.8099 | 630 |
| 640 | 2.3397 | 3793.7 | 8.9273 | 2.1056 | 3793.6 | 8.8786 | 1.9140 | 3793.4 | 8.8345 | 640 |
| 650 | 2.3654 | 3816.1 | 8.9517 | 2.1287 | 3815.9 | 8.9029 | 1.9351 | 3815.8 | 8.8588 | 650 |
| 660 | 2.3911 | 3838.5 | 8.9758 | 2.1519 | 3838.4 | 8.9271 | 1.9561 | 3838.2 | 8.8830 | 660 |
| 670 | 2.4168 | 3861.0 | 8.9998 | 2.1750 | 3860.9 | 8.9511 | 1.9771 | 3860.7 | 8.9070 | 670 |
| 680 | 2.4425 | 3883.6 | 9.0236 | 2.1981 | 3883.4 | 8.9749 | 1.9982 | 3883.3 | 8.9308 | 680 |
| 690 | 2.4682 | 3906.2 | 9.0473 | 2.2212 | 3906.1 | 8.9985 | 2.0192 | 3906.0 | 8.9545 | 690 |
| 700 | 2.4939 | 3928.9 | 9.0707 | 2.2444 | 3928.8 | 9.0220 | 2.0402 | 3928.7 | 8.9779 | 700 |
| 710 | 2.5196 | 3951.7 | 9.0940 | 2.2675 | 3951.6 | 9.0453 | 2.0612 | 3951.5 | 9.0012 | 710 |
| 720 | 2.5453 | 3974.5 | 9.1171 | 2.2906 | 3974.4 | 9.0684 | 2.0823 | 3974.3 | 9.0243 | 720 |
| 730 | 2.5709 | 3997.5 | 9.1401 | 2.3137 | 3997.4 | 9.0914 | 2.1033 | 3997.2 | 9.0473 | 730 |
| 740 | 2.5966 | 4020.5 | 9.1629 | 2.3368 | 4020.3 | 9.1142 | 2.1243 | 4020.2 | 9.0701 | 740 |
| 750 | 2.6223 | 4043.5 | 9.1855 | 2.3600 | 4043.4 | 9.1368 | 2.1453 | 4043.3 | 9.0928 | 750 |
| 760 | 2.6480 | 4066.6 | 9.2080 | 2.3831 | 4066.5 | 9.1593 | 2.1663 | 4066.4 | 9.1153 | 760 |
| 770 | 2.6737 | 4089.8 | 9.2304 | 2.4062 | 4089.7 | 9.1817 | 2.1874 | 4089.6 | 9.1376 | 770 |
| 780 | 2.6993 | 4113.1 | 9.2526 | 2.4293 | 4113.0 | 9.2039 | 2.2084 | 4112.9 | 9.1598 | 780 |
| 790 | 2.7250 | 4136.4 | 9.2746 | 2.4524 | 4136.3 | 9.2259 | 2.2294 | 4136.3 | 9.1819 | 790 |
| 800 | 2.7507 | 4159.9 | 9.2966 | 2.4755 | 4159.8 | 9.2479 | 2.2504 | 4159.7 | 9.2038 | 800 |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.24 MPa ($t_{sat}$ = 126.07 °C) | | | 0.26 MPa ($t_{sat}$ = 128.71 °C) | | | 0.28 MPa ($t_{sat}$ = 131.19 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 065 9 | 529.64 | 1.5930 | 0.001 068 5 | 540.88 | 1.6210 | 0.001 070 9 | 551.46 | 1.6472 | Sat. Liq. |
| Sat. Vap. | 0.746 72 | 2714.6 | 7.0660 | 0.692 76 | 2718.3 | 7.0393 | 0.646 27 | 2721.7 | 7.0146 | Sat. Vap. |
| 0 | 0.001 000 1 | 0.20 | -0.0001 | 0.001 000 1 | 0.22 | -0.0001 | 0.001 000 1 | 0.24 | -0.0001 | 0 |
| 5 | 0.001 000 0 | 21.26 | 0.0762 | 0.001 000 0 | 21.28 | 0.0762 | 0.000 999 9 | 21.30 | 0.0762 | 5 |
| 10 | 0.001 000 2 | 42.25 | 0.1511 | 0.001 000 2 | 42.27 | 0.1511 | 0.001 000 2 | 42.29 | 0.1511 | 10 |
| 15 | 0.001 000 8 | 63.21 | 0.2244 | 0.001 000 8 | 63.23 | 0.2244 | 0.001 000 8 | 63.25 | 0.2244 | 15 |
| 20 | 0.001 001 7 | 84.14 | 0.2965 | 0.001 001 7 | 84.16 | 0.2964 | 0.001 001 7 | 84.18 | 0.2964 | 20 |
| 25 | 0.001 002 9 | 105.06 | 0.3672 | 0.001 002 9 | 105.08 | 0.3672 | 0.001 002 9 | 105.09 | 0.3672 | 25 |
| 30 | 0.001 004 3 | 125.96 | 0.4367 | 0.001 004 3 | 125.98 | 0.4367 | 0.001 004 3 | 126.00 | 0.4367 | 30 |
| 35 | 0.001 005 9 | 146.86 | 0.5051 | 0.001 005 9 | 146.87 | 0.5051 | 0.001 005 9 | 146.89 | 0.5051 | 35 |
| 40 | 0.001 007 8 | 167.75 | 0.5723 | 0.001 007 8 | 167.76 | 0.5723 | 0.001 007 8 | 167.78 | 0.5723 | 40 |
| 45 | 0.001 009 8 | 188.64 | 0.6385 | 0.001 009 8 | 188.66 | 0.6385 | 0.001 009 8 | 188.67 | 0.6385 | 45 |
| 50 | 0.001 012 0 | 209.53 | 0.7037 | 0.001 012 0 | 209.55 | 0.7037 | 0.001 012 0 | 209.57 | 0.7037 | 50 |
| 55 | 0.001 014 4 | 230.43 | 0.7679 | 0.001 014 4 | 230.45 | 0.7679 | 0.001 014 4 | 230.47 | 0.7678 | 55 |
| 60 | 0.001 017 0 | 251.34 | 0.8311 | 0.001 017 0 | 251.36 | 0.8311 | 0.001 017 0 | 251.37 | 0.8311 | 60 |
| 65 | 0.001 019 8 | 272.26 | 0.8934 | 0.001 019 7 | 272.27 | 0.8934 | 0.001 019 7 | 272.29 | 0.8934 | 65 |
| 70 | 0.001 022 7 | 293.19 | 0.9549 | 0.001 022 7 | 293.21 | 0.9549 | 0.001 022 6 | 293.22 | 0.9548 | 70 |
| 75 | 0.001 025 7 | 314.14 | 1.0155 | 0.001 025 7 | 314.15 | 1.0155 | 0.001 025 7 | 314.17 | 1.0154 | 75 |
| 80 | 0.001 028 9 | 335.10 | 1.0753 | 0.001 028 9 | 335.12 | 1.0753 | 0.001 028 9 | 335.13 | 1.0752 | 80 |
| 85 | 0.001 032 3 | 356.09 | 1.1343 | 0.001 032 3 | 356.10 | 1.1343 | 0.001 032 3 | 356.12 | 1.1342 | 85 |
| 90 | 0.001 035 9 | 377.10 | 1.1925 | 0.001 035 8 | 377.12 | 1.1925 | 0.001 035 8 | 377.13 | 1.1925 | 90 |
| 95 | 0.001 039 5 | 398.14 | 1.2501 | 0.001 039 5 | 398.15 | 1.2501 | 0.001 039 5 | 398.17 | 1.2500 | 95 |
| 100 | 0.001 043 4 | 419.20 | 1.3069 | 0.001 043 4 | 419.22 | 1.3069 | 0.001 043 4 | 419.23 | 1.3069 | 100 |
| 105 | 0.001 047 4 | 440.30 | 1.3631 | 0.001 047 4 | 440.32 | 1.3631 | 0.001 047 4 | 440.33 | 1.3630 | 105 |
| 110 | 0.001 051 5 | 461.43 | 1.4186 | 0.001 051 5 | 461.45 | 1.4186 | 0.001 051 5 | 461.46 | 1.4186 | 110 |
| 115 | 0.001 055 8 | 482.60 | 1.4735 | 0.001 055 8 | 482.62 | 1.4735 | 0.001 055 8 | 482.63 | 1.4734 | 115 |
| 120 | 0.001 060 3 | 503.81 | 1.5278 | 0.001 060 3 | 503.83 | 1.5278 | 0.001 060 3 | 503.84 | 1.5277 | 120 |
| 125 | 0.001 064 9 | 525.07 | 1.5815 | 0.001 064 9 | 525.08 | 1.5815 | 0.001 064 9 | 525.09 | 1.5815 | 125 |
| 130 | 0.755 10 | 2723.2 | 7.0875 | 0.695 33 | 2721.2 | 7.0464 | 0.001 069 7 | 546.39 | 1.6346 | 130 |
| 135 | 0.765 69 | 2734.1 | 7.1142 | 0.705 20 | 2732.2 | 7.0736 | 0.653 33 | 2730.2 | 7.0355 | 135 |
| 140 | 0.776 19 | 2744.8 | 7.1404 | 0.714 98 | 2743.0 | 7.1000 | 0.662 50 | 2741.2 | 7.0623 | 140 |
| 145 | 0.786 63 | 2755.4 | 7.1659 | 0.724 69 | 2753.8 | 7.1258 | 0.671 58 | 2752.1 | 7.0884 | 145 |
| 150 | 0.797 00 | 2766.0 | 7.1910 | 0.734 33 | 2764.4 | 7.1511 | 0.680 61 | 2762.8 | 7.1139 | 150 |
| 155 | 0.807 32 | 2776.5 | 7.2156 | 0.743 92 | 2775.0 | 7.1759 | 0.689 57 | 2773.5 | 7.1390 | 155 |
| 160 | 0.817 60 | 2786.9 | 7.2398 | 0.753 46 | 2785.5 | 7.2003 | 0.698 48 | 2784.0 | 7.1635 | 160 |
| 165 | 0.827 82 | 2797.2 | 7.2636 | 0.762 96 | 2795.9 | 7.2243 | 0.707 35 | 2794.6 | 7.1877 | 165 |
| 170 | 0.838 01 | 2807.6 | 7.2870 | 0.772 41 | 2806.3 | 7.2479 | 0.716 18 | 2805.0 | 7.2114 | 170 |
| 175 | 0.848 17 | 2817.9 | 7.3101 | 0.781 83 | 2816.6 | 7.2711 | 0.724 97 | 2815.4 | 7.2348 | 175 |
| 180 | 0.858 29 | 2828.1 | 7.3329 | 0.791 22 | 2827.0 | 7.2940 | 0.733 72 | 2825.8 | 7.2578 | 180 |
| 185 | 0.868 38 | 2838.3 | 7.3553 | 0.800 57 | 2837.2 | 7.3165 | 0.742 45 | 2836.1 | 7.2804 | 185 |
| 190 | 0.878 44 | 2848.5 | 7.3774 | 0.809 90 | 2847.5 | 7.3388 | 0.751 15 | 2846.4 | 7.3028 | 190 |
| 195 | 0.888 48 | 2858.7 | 7.3993 | 0.819 20 | 2857.7 | 7.3607 | 0.759 82 | 2856.7 | 7.3248 | 195 |
| 200 | 0.898 49 | 2868.9 | 7.4209 | 0.828 48 | 2867.9 | 7.3824 | 0.768 46 | 2866.9 | 7.3466 | 200 |
| 205 | 0.908 49 | 2879.0 | 7.4422 | 0.837 73 | 2878.1 | 7.4038 | 0.777 09 | 2877.1 | 7.3681 | 205 |
| 210 | 0.918 46 | 2889.1 | 7.4633 | 0.846 97 | 2888.2 | 7.4249 | 0.785 69 | 2887.4 | 7.3893 | 210 |
| 215 | 0.928 42 | 2899.3 | 7.4841 | 0.856 19 | 2898.4 | 7.4458 | 0.794 28 | 2897.5 | 7.4103 | 215 |
| 220 | 0.938 35 | 2909.4 | 7.5047 | 0.865 39 | 2908.5 | 7.4665 | 0.802 84 | 2907.7 | 7.4310 | 220 |
| 225 | 0.948 28 | 2919.5 | 7.5251 | 0.874 57 | 2918.7 | 7.4870 | 0.811 40 | 2917.9 | 7.4515 | 225 |
| 230 | 0.958 18 | 2929.6 | 7.5453 | 0.883 74 | 2928.8 | 7.5072 | 0.819 93 | 2928.0 | 7.4718 | 230 |
| 235 | 0.968 08 | 2939.7 | 7.5652 | 0.892 90 | 2938.9 | 7.5272 | 0.828 45 | 2938.2 | 7.4919 | 235 |
| 240 | 0.977 96 | 2949.8 | 7.5850 | 0.902 04 | 2949.0 | 7.5470 | 0.836 96 | 2948.3 | 7.5118 | 240 |
| 245 | 0.987 83 | 2959.8 | 7.6046 | 0.911 17 | 2959.2 | 7.5666 | 0.845 46 | 2958.5 | 7.5314 | 245 |
| 250 | 0.997 69 | 2969.9 | 7.6240 | 0.920 29 | 2969.3 | 7.5861 | 0.853 95 | 2968.6 | 7.5509 | 250 |
| 255 | 1.0075 | 2980.0 | 7.6432 | 0.929 40 | 2979.4 | 7.6053 | 0.862 42 | 2978.7 | 7.5702 | 255 |
| 260 | 1.0174 | 2990.1 | 7.6622 | 0.938 50 | 2989.5 | 7.6244 | 0.870 89 | 2988.9 | 7.5893 | 260 |
| 265 | 1.0272 | 3000.2 | 7.6810 | 0.947 59 | 2999.6 | 7.6433 | 0.879 35 | 2999.0 | 7.6082 | 265 |
| 270 | 1.0370 | 3010.3 | 7.6997 | 0.956 67 | 3009.7 | 7.6620 | 0.887 79 | 3009.2 | 7.6270 | 270 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.24 MPa ($t_{sat}$ = 126.07 °C) | | | 0.26 MPa ($t_{sat}$ = 128.71 °C) | | | 0.28 MPa ($t_{sat}$ = 131.19 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 1.0468 | 3020.4 | 7.7183 | 0.965 74 | 3019.9 | 7.6805 | 0.896 23 | 3019.3 | 7.6456 | 275 |
| 280 | 1.0566 | 3030.6 | 7.7366 | 0.974 81 | 3030.0 | 7.6989 | 0.904 67 | 3029.5 | 7.6640 | 280 |
| 285 | 1.0664 | 3040.7 | 7.7548 | 0.983 87 | 3040.1 | 7.7172 | 0.913 09 | 3039.6 | 7.6823 | 285 |
| 290 | 1.0762 | 3050.8 | 7.7729 | 0.992 92 | 3050.3 | 7.7353 | 0.921 51 | 3049.8 | 7.7004 | 290 |
| 295 | 1.0860 | 3060.9 | 7.7908 | 1.0020 | 3060.4 | 7.7532 | 0.929 92 | 3059.9 | 7.7184 | 295 |
| 300 | 1.0958 | 3071.1 | 7.8086 | 1.0110 | 3070.6 | 7.7710 | 0.938 33 | 3070.1 | 7.7362 | 300 |
| 310 | 1.1153 | 3091.4 | 7.8438 | 1.0291 | 3090.9 | 7.8062 | 0.955 12 | 3090.5 | 7.7714 | 310 |
| 320 | 1.1348 | 3111.8 | 7.8784 | 1.0471 | 3111.3 | 7.8409 | 0.971 89 | 3110.9 | 7.8061 | 320 |
| 330 | 1.1543 | 3132.2 | 7.9125 | 1.0651 | 3131.8 | 7.8750 | 0.988 64 | 3131.3 | 7.8403 | 330 |
| 340 | 1.1738 | 3152.6 | 7.9461 | 1.0831 | 3152.2 | 7.9087 | 1.0054 | 3151.8 | 7.8740 | 340 |
| 350 | 1.1933 | 3173.1 | 7.9793 | 1.1011 | 3172.7 | 7.9419 | 1.0221 | 3172.3 | 7.9072 | 350 |
| 360 | 1.2127 | 3193.7 | 8.0120 | 1.1191 | 3193.3 | 7.9746 | 1.0388 | 3192.9 | 7.9400 | 360 |
| 370 | 1.2322 | 3214.3 | 8.0442 | 1.1370 | 3213.9 | 8.0069 | 1.0555 | 3213.5 | 7.9723 | 370 |
| 380 | 1.2516 | 3234.9 | 8.0761 | 1.1550 | 3234.6 | 8.0388 | 1.0722 | 3234.2 | 8.0042 | 380 |
| 390 | 1.2710 | 3255.6 | 8.1076 | 1.1729 | 3255.3 | 8.0703 | 1.0888 | 3255.0 | 8.0357 | 390 |
| 400 | 1.2904 | 3276.4 | 8.1386 | 1.1909 | 3276.0 | 8.1013 | 1.1055 | 3275.7 | 8.0668 | 400 |
| 410 | 1.3098 | 3297.2 | 8.1693 | 1.2088 | 3296.9 | 8.1321 | 1.1222 | 3296.6 | 8.0975 | 410 |
| 420 | 1.3292 | 3318.0 | 8.1996 | 1.2267 | 3317.8 | 8.1624 | 1.1388 | 3317.5 | 8.1279 | 420 |
| 430 | 1.3486 | 3339.0 | 8.2296 | 1.2446 | 3338.7 | 8.1924 | 1.1554 | 3338.4 | 8.1579 | 430 |
| 440 | 1.3680 | 3360.0 | 8.2593 | 1.2625 | 3359.7 | 8.2220 | 1.1721 | 3359.4 | 8.1876 | 440 |
| 450 | 1.3873 | 3381.0 | 8.2886 | 1.2804 | 3380.8 | 8.2514 | 1.1887 | 3380.5 | 8.2169 | 450 |
| 460 | 1.4067 | 3402.1 | 8.3176 | 1.2982 | 3401.9 | 8.2804 | 1.2053 | 3401.6 | 8.2459 | 460 |
| 470 | 1.4261 | 3423.3 | 8.3463 | 1.3161 | 3423.1 | 8.3091 | 1.2219 | 3422.8 | 8.2746 | 470 |
| 480 | 1.4454 | 3444.5 | 8.3746 | 1.3340 | 3444.3 | 8.3375 | 1.2385 | 3444.1 | 8.3030 | 480 |
| 490 | 1.4647 | 3465.8 | 8.4027 | 1.3519 | 3465.6 | 8.3656 | 1.2551 | 3465.4 | 8.3312 | 490 |
| 500 | 1.4841 | 3487.2 | 8.4306 | 1.3697 | 3487.0 | 8.3934 | 1.2717 | 3486.8 | 8.3590 | 500 |
| 510 | 1.5034 | 3508.6 | 8.4581 | 1.3876 | 3508.4 | 8.4210 | 1.2883 | 3508.2 | 8.3866 | 510 |
| 520 | 1.5227 | 3530.1 | 8.4854 | 1.4054 | 3529.9 | 8.4482 | 1.3048 | 3529.7 | 8.4138 | 520 |
| 530 | 1.5421 | 3551.7 | 8.5124 | 1.4233 | 3551.5 | 8.4753 | 1.3214 | 3551.3 | 8.4409 | 530 |
| 540 | 1.5614 | 3573.3 | 8.5391 | 1.4411 | 3573.1 | 8.5020 | 1.3380 | 3572.9 | 8.4677 | 540 |
| 550 | 1.5807 | 3595.0 | 8.5657 | 1.4589 | 3594.8 | 8.5286 | 1.3546 | 3594.6 | 8.4942 | 550 |
| 560 | 1.6000 | 3616.8 | 8.5919 | 1.4768 | 3616.6 | 8.5548 | 1.3711 | 3616.4 | 8.5205 | 560 |
| 570 | 1.6193 | 3638.6 | 8.6180 | 1.4946 | 3638.4 | 8.5809 | 1.3877 | 3638.3 | 8.5465 | 570 |
| 580 | 1.6386 | 3660.5 | 8.6438 | 1.5124 | 3660.3 | 8.6067 | 1.4042 | 3660.2 | 8.5724 | 580 |
| 590 | 1.6579 | 3682.5 | 8.6694 | 1.5302 | 3682.3 | 8.6323 | 1.4208 | 3682.1 | 8.5980 | 590 |
| 600 | 1.6772 | 3704.5 | 8.6948 | 1.5481 | 3704.3 | 8.6577 | 1.4374 | 3704.2 | 8.6233 | 600 |
| 610 | 1.6965 | 3726.6 | 8.7199 | 1.5659 | 3726.4 | 8.6829 | 1.4539 | 3726.3 | 8.6485 | 610 |
| 620 | 1.7158 | 3748.7 | 8.7449 | 1.5837 | 3748.6 | 8.7078 | 1.4704 | 3748.5 | 8.6735 | 620 |
| 630 | 1.7351 | 3771.0 | 8.7696 | 1.6015 | 3770.8 | 8.7326 | 1.4870 | 3770.7 | 8.6983 | 630 |
| 640 | 1.7544 | 3793.3 | 8.7942 | 1.6193 | 3793.2 | 8.7571 | 1.5035 | 3793.0 | 8.7228 | 640 |
| 650 | 1.7737 | 3815.7 | 8.8186 | 1.6371 | 3815.5 | 8.7815 | 1.5201 | 3815.4 | 8.7472 | 650 |
| 660 | 1.7930 | 3838.1 | 8.8427 | 1.6549 | 3838.0 | 8.8057 | 1.5366 | 3837.8 | 8.7714 | 660 |
| 670 | 1.8123 | 3860.6 | 8.8667 | 1.6727 | 3860.5 | 8.8297 | 1.5532 | 3860.4 | 8.7954 | 670 |
| 680 | 1.8315 | 3883.2 | 8.8906 | 1.6905 | 3883.1 | 8.8535 | 1.5697 | 3882.9 | 8.8192 | 680 |
| 690 | 1.8508 | 3905.8 | 8.9142 | 1.7083 | 3905.7 | 8.8772 | 1.5862 | 3905.6 | 8.8429 | 690 |
| 700 | 1.8701 | 3928.6 | 8.9377 | 1.7261 | 3928.4 | 8.9006 | 1.6027 | 3928.3 | 8.8663 | 700 |
| 710 | 1.8894 | 3951.4 | 8.9610 | 1.7439 | 3951.2 | 8.9239 | 1.6193 | 3951.1 | 8.8896 | 710 |
| 720 | 1.9086 | 3974.2 | 8.9841 | 1.7617 | 3974.1 | 8.9471 | 1.6358 | 3974.0 | 8.9128 | 720 |
| 730 | 1.9279 | 3997.1 | 9.0071 | 1.7795 | 3997.0 | 8.9700 | 1.6523 | 3996.9 | 8.9358 | 730 |
| 740 | 1.9472 | 4020.1 | 9.0299 | 1.7973 | 4020.0 | 8.9929 | 1.6689 | 4019.9 | 8.9586 | 740 |
| 750 | 1.9665 | 4043.2 | 9.0525 | 1.8151 | 4043.1 | 9.0155 | 1.6854 | 4043.0 | 8.9812 | 750 |
| 760 | 1.9857 | 4066.3 | 9.0750 | 1.8329 | 4066.2 | 9.0380 | 1.7019 | 4066.1 | 9.0037 | 760 |
| 770 | 2.0050 | 4089.5 | 9.0974 | 1.8507 | 4089.4 | 9.0604 | 1.7184 | 4089.4 | 9.0261 | 770 |
| 780 | 2.0243 | 4112.8 | 9.1196 | 1.8685 | 4112.7 | 9.0826 | 1.7349 | 4112.6 | 9.0483 | 780 |
| 790 | 2.0435 | 4136.2 | 9.1417 | 1.8863 | 4136.1 | 9.1046 | 1.7515 | 4136.0 | 9.0704 | 790 |
| 800 | 2.0628 | 4159.6 | 9.1636 | 1.9040 | 4159.5 | 9.1266 | 1.7680 | 4159.4 | 9.0923 | 800 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.30 MPa ($t_{sat}$ = 133.53 °C) | | | 0.34 MPa ($t_{sat}$ = 137.85 °C) | | | 0.38 MPa ($t_{sat}$ = 141.77 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 073 2 | 561.46 | 1.6718 | 0.001 077 5 | 579.96 | 1.7169 | 0.001 081 6 | 596.81 | 1.7576 | Sat. Liq. |
| Sat. Vap. | 0.605 79 | 2724.9 | 6.9916 | 0.538 66 | 2730.6 | 6.9498 | 0.485 23 | 2735.7 | 6.9126 | Sat. Vap. |
| 0 | 0.001 000 1 | 0.26 | -0.0001 | 0.001 000 0 | 0.30 | -0.0001 | 0.001 000 0 | 0.34 | -0.0001 | 0 |
| 5 | 0.000 999 9 | 21.32 | 0.0762 | 0.000 999 9 | 21.36 | 0.0762 | 0.000 999 9 | 21.40 | 0.0762 | 5 |
| 10 | 0.001 000 2 | 42.31 | 0.1511 | 0.001 000 2 | 42.35 | 0.1511 | 0.001 000 2 | 42.39 | 0.1511 | 10 |
| 15 | 0.001 000 8 | 63.27 | 0.2244 | 0.001 000 8 | 63.31 | 0.2244 | 0.001 000 8 | 63.35 | 0.2244 | 15 |
| 20 | 0.001 001 7 | 84.20 | 0.2964 | 0.001 001 7 | 84.24 | 0.2964 | 0.001 001 7 | 84.28 | 0.2964 | 20 |
| 25 | 0.001 002 9 | 105.11 | 0.3672 | 0.001 002 9 | 105.15 | 0.3672 | 0.001 002 8 | 105.19 | 0.3672 | 25 |
| 30 | 0.001 004 3 | 126.01 | 0.4367 | 0.001 004 3 | 126.05 | 0.4367 | 0.001 004 2 | 126.09 | 0.4367 | 30 |
| 35 | 0.001 005 9 | 146.91 | 0.5051 | 0.001 005 9 | 146.95 | 0.5051 | 0.001 005 9 | 146.98 | 0.5050 | 35 |
| 40 | 0.001 007 7 | 167.80 | 0.5723 | 0.001 007 7 | 167.84 | 0.5723 | 0.001 007 7 | 167.87 | 0.5723 | 40 |
| 45 | 0.001 009 8 | 188.69 | 0.6385 | 0.001 009 8 | 188.73 | 0.6385 | 0.001 009 7 | 188.76 | 0.6385 | 45 |
| 50 | 0.001 012 0 | 209.58 | 0.7037 | 0.001 012 0 | 209.62 | 0.7036 | 0.001 012 0 | 209.65 | 0.7036 | 50 |
| 55 | 0.001 014 4 | 230.48 | 0.7678 | 0.001 014 4 | 230.52 | 0.7678 | 0.001 014 4 | 230.55 | 0.7678 | 55 |
| 60 | 0.001 017 0 | 251.39 | 0.8311 | 0.001 017 0 | 251.42 | 0.8310 | 0.001 017 0 | 251.46 | 0.8310 | 60 |
| 65 | 0.001 019 7 | 272.31 | 0.8934 | 0.001 019 7 | 272.34 | 0.8934 | 0.001 019 7 | 272.37 | 0.8933 | 65 |
| 70 | 0.001 022 6 | 293.24 | 0.9548 | 0.001 022 6 | 293.27 | 0.9548 | 0.001 022 6 | 293.30 | 0.9548 | 70 |
| 75 | 0.001 025 7 | 314.18 | 1.0154 | 0.001 025 7 | 314.22 | 1.0154 | 0.001 025 7 | 314.25 | 1.0154 | 75 |
| 80 | 0.001 028 9 | 335.15 | 1.0752 | 0.001 028 9 | 335.18 | 1.0752 | 0.001 028 9 | 335.21 | 1.0752 | 80 |
| 85 | 0.001 032 3 | 356.14 | 1.1342 | 0.001 032 3 | 356.17 | 1.1342 | 0.001 032 3 | 356.20 | 1.1342 | 85 |
| 90 | 0.001 035 8 | 377.15 | 1.1925 | 0.001 035 8 | 377.18 | 1.1925 | 0.001 035 8 | 377.21 | 1.1924 | 90 |
| 95 | 0.001 039 5 | 398.18 | 1.2500 | 0.001 039 5 | 398.21 | 1.2500 | 0.001 039 5 | 398.24 | 1.2500 | 95 |
| 100 | 0.001 043 4 | 419.25 | 1.3069 | 0.001 043 3 | 419.28 | 1.3068 | 0.001 043 3 | 419.31 | 1.3068 | 100 |
| 105 | 0.001 047 3 | 440.35 | 1.3630 | 0.001 047 3 | 440.38 | 1.3630 | 0.001 047 3 | 440.40 | 1.3630 | 105 |
| 110 | 0.001 051 5 | 461.48 | 1.4185 | 0.001 051 5 | 461.51 | 1.4185 | 0.001 051 5 | 461.54 | 1.4185 | 110 |
| 115 | 0.001 055 8 | 482.65 | 1.4734 | 0.001 055 8 | 482.67 | 1.4734 | 0.001 055 8 | 482.70 | 1.4734 | 115 |
| 120 | 0.001 060 3 | 503.86 | 1.5277 | 0.001 060 2 | 503.88 | 1.5277 | 0.001 060 2 | 503.91 | 1.5277 | 120 |
| 125 | 0.001 064 9 | 525.11 | 1.5814 | 0.001 064 9 | 525.14 | 1.5814 | 0.001 064 9 | 525.16 | 1.5814 | 125 |
| 130 | 0.001 069 7 | 546.41 | 1.6346 | 0.001 069 7 | 546.44 | 1.6346 | 0.001 069 6 | 546.46 | 1.6345 | 130 |
| 135 | 0.608 35 | 2728.2 | 6.9997 | 0.001 074 6 | 567.78 | 1.6872 | 0.001 074 6 | 567.81 | 1.6872 | 135 |
| 140 | 0.616 99 | 2739.4 | 7.0269 | 0.542 00 | 2735.6 | 6.9617 | 0.001 079 7 | 589.21 | 1.7393 | 140 |
| 145 | 0.625 55 | 2750.3 | 7.0533 | 0.549 69 | 2746.8 | 6.9888 | 0.489 75 | 2743.2 | 6.9305 | 145 |
| 150 | 0.634 03 | 2761.2 | 7.0791 | 0.557 29 | 2757.9 | 7.0151 | 0.496 67 | 2754.5 | 6.9574 | 150 |
| 155 | 0.642 46 | 2771.9 | 7.1043 | 0.564 83 | 2768.8 | 7.0408 | 0.503 51 | 2765.7 | 6.9836 | 155 |
| 160 | 0.650 83 | 2782.6 | 7.1291 | 0.572 31 | 2779.7 | 7.0660 | 0.510 30 | 2776.7 | 7.0093 | 160 |
| 165 | 0.659 15 | 2793.2 | 7.1534 | 0.579 75 | 2790.4 | 7.0907 | 0.517 03 | 2787.6 | 7.0343 | 165 |
| 170 | 0.667 44 | 2803.7 | 7.1773 | 0.587 14 | 2801.1 | 7.1149 | 0.523 72 | 2798.4 | 7.0589 | 170 |
| 175 | 0.675 68 | 2814.2 | 7.2008 | 0.594 49 | 2811.7 | 7.1387 | 0.530 37 | 2809.2 | 7.0830 | 175 |
| 180 | 0.683 89 | 2824.6 | 7.2239 | 0.601 80 | 2822.3 | 7.1621 | 0.536 98 | 2819.9 | 7.1067 | 180 |
| 185 | 0.692 07 | 2835.0 | 7.2467 | 0.609 08 | 2832.7 | 7.1851 | 0.543 55 | 2830.5 | 7.1299 | 185 |
| 190 | 0.700 22 | 2845.4 | 7.2692 | 0.616 33 | 2843.2 | 7.2078 | 0.550 09 | 2841.0 | 7.1529 | 190 |
| 195 | 0.708 34 | 2855.7 | 7.2913 | 0.623 56 | 2853.6 | 7.2302 | 0.556 61 | 2851.5 | 7.1754 | 195 |
| 200 | 0.716 44 | 2866.0 | 7.3132 | 0.630 76 | 2864.0 | 7.2522 | 0.563 10 | 2862.0 | 7.1977 | 200 |
| 205 | 0.724 52 | 2876.2 | 7.3348 | 0.637 94 | 2874.3 | 7.2740 | 0.569 57 | 2872.4 | 7.2196 | 205 |
| 210 | 0.732 58 | 2886.5 | 7.3561 | 0.645 09 | 2884.6 | 7.2954 | 0.576 02 | 2882.8 | 7.2412 | 210 |
| 215 | 0.740 62 | 2896.7 | 7.3771 | 0.652 23 | 2894.9 | 7.3166 | 0.582 44 | 2893.2 | 7.2626 | 215 |
| 220 | 0.748 64 | 2906.9 | 7.3979 | 0.659 35 | 2905.2 | 7.3376 | 0.588 85 | 2903.5 | 7.2837 | 220 |
| 225 | 0.756 64 | 2917.1 | 7.4185 | 0.666 45 | 2915.5 | 7.3583 | 0.595 24 | 2913.9 | 7.3045 | 225 |
| 230 | 0.764 63 | 2927.3 | 7.4388 | 0.673 54 | 2925.7 | 7.3787 | 0.601 62 | 2924.2 | 7.3251 | 230 |
| 235 | 0.772 60 | 2937.4 | 7.4590 | 0.680 61 | 2935.9 | 7.3990 | 0.607 98 | 2934.4 | 7.3454 | 235 |
| 240 | 0.780 56 | 2947.6 | 7.4789 | 0.687 67 | 2946.2 | 7.4190 | 0.614 32 | 2944.7 | 7.3655 | 240 |
| 245 | 0.788 51 | 2957.8 | 7.4986 | 0.694 71 | 2956.4 | 7.4388 | 0.620 66 | 2955.0 | 7.3854 | 245 |
| 250 | 0.796 45 | 2967.9 | 7.5181 | 0.701 75 | 2966.6 | 7.4584 | 0.626 98 | 2965.2 | 7.4051 | 250 |
| 255 | 0.804 38 | 2978.1 | 7.5374 | 0.708 77 | 2976.8 | 7.4778 | 0.633 29 | 2975.5 | 7.4246 | 255 |
| 260 | 0.812 30 | 2988.2 | 7.5566 | 0.715 79 | 2987.0 | 7.4970 | 0.639 59 | 2985.7 | 7.4439 | 260 |
| 265 | 0.820 20 | 2998.4 | 7.5755 | 0.722 79 | 2997.2 | 7.5161 | 0.645 88 | 2996.0 | 7.4630 | 265 |
| 270 | 0.828 10 | 3008.6 | 7.5943 | 0.729 79 | 3007.4 | 7.5349 | 0.652 16 | 3006.2 | 7.4820 | 270 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 0.30 MPa ($t_{sat}$ = 133.53 °C) | | | 0.34 MPa ($t_{sat}$ = 137.85 °C) | | | 0.38 MPa ($t_{sat}$ = 141.77 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| 275 | 0.835 99 | 3018.7 | 7.6129 | 0.736 77 | 3017.6 | 7.5536 | 0.658 44 | 3016.4 | 7.5007 | 275 |
| 280 | 0.843 88 | 3028.9 | 7.6314 | 0.743 75 | 3027.8 | 7.5721 | 0.664 70 | 3026.7 | 7.5193 | 280 |
| 285 | 0.851 75 | 3039.1 | 7.6497 | 0.750 72 | 3038.0 | 7.5905 | 0.670 96 | 3036.9 | 7.5377 | 285 |
| 290 | 0.859 62 | 3049.2 | 7.6679 | 0.757 69 | 3048.2 | 7.6087 | 0.677 21 | 3047.1 | 7.5560 | 290 |
| 295 | 0.867 48 | 3059.4 | 7.6859 | 0.764 65 | 3058.4 | 7.6268 | 0.683 46 | 3057.4 | 7.5741 | 295 |
| 300 | 0.875 34 | 3069.6 | 7.7037 | 0.771 60 | 3068.6 | 7.6447 | 0.689 69 | 3067.6 | 7.5920 | 300 |
| 310 | 0.891 03 | 3090.0 | 7.7390 | 0.785 48 | 3089.1 | 7.6800 | 0.702 15 | 3088.1 | 7.6275 | 310 |
| 320 | 0.906 71 | 3110.4 | 7.7737 | 0.799 35 | 3109.5 | 7.7148 | 0.714 59 | 3108.6 | 7.6624 | 320 |
| 330 | 0.922 36 | 3130.9 | 7.8079 | 0.813 19 | 3130.0 | 7.7491 | 0.727 01 | 3129.2 | 7.6967 | 330 |
| 340 | 0.938 00 | 3151.4 | 7.8417 | 0.827 02 | 3150.6 | 7.7829 | 0.739 41 | 3149.8 | 7.7306 | 340 |
| 350 | 0.953 62 | 3172.0 | 7.8749 | 0.840 83 | 3171.2 | 7.8162 | 0.751 79 | 3170.4 | 7.7640 | 350 |
| 360 | 0.969 23 | 3192.6 | 7.9077 | 0.854 63 | 3191.8 | 7.8491 | 0.764 16 | 3191.1 | 7.7969 | 360 |
| 370 | 0.984 82 | 3213.2 | 7.9400 | 0.868 42 | 3212.5 | 7.8815 | 0.776 52 | 3211.8 | 7.8293 | 370 |
| 380 | 1.0004 | 3233.9 | 7.9720 | 0.882 19 | 3233.2 | 7.9134 | 0.788 86 | 3232.5 | 7.8613 | 380 |
| 390 | 1.0160 | 3254.6 | 8.0035 | 0.895 95 | 3254.0 | 7.9450 | 0.801 19 | 3253.3 | 7.8929 | 390 |
| 400 | 1.0315 | 3275.4 | 8.0346 | 0.909 70 | 3274.8 | 7.9762 | 0.813 52 | 3274.2 | 7.9241 | 400 |
| 410 | 1.0471 | 3296.3 | 8.0654 | 0.923 44 | 3295.7 | 8.0069 | 0.825 83 | 3295.1 | 7.9550 | 410 |
| 420 | 1.0626 | 3317.2 | 8.0957 | 0.937 18 | 3316.6 | 8.0374 | 0.838 13 | 3316.0 | 7.9854 | 420 |
| 430 | 1.0782 | 3338.1 | 8.1258 | 0.950 90 | 3337.6 | 8.0674 | 0.850 43 | 3337.0 | 8.0155 | 430 |
| 440 | 1.0937 | 3359.2 | 8.1554 | 0.964 62 | 3358.6 | 8.0971 | 0.862 72 | 3358.1 | 8.0452 | 440 |
| 450 | 1.1092 | 3380.2 | 8.1848 | 0.978 33 | 3379.7 | 8.1265 | 0.875 00 | 3379.2 | 8.0746 | 450 |
| 460 | 1.1247 | 3401.4 | 8.2138 | 0.992 03 | 3400.9 | 8.1556 | 0.887 27 | 3400.4 | 8.1037 | 460 |
| 470 | 1.1402 | 3422.6 | 8.2426 | 1.0057 | 3422.1 | 8.1843 | 0.899 54 | 3421.6 | 8.1325 | 470 |
| 480 | 1.1557 | 3443.8 | 8.2710 | 1.0194 | 3443.4 | 8.2128 | 0.911 80 | 3442.9 | 8.1610 | 480 |
| 490 | 1.1712 | 3465.2 | 8.2991 | 1.0331 | 3464.7 | 8.2409 | 0.924 06 | 3464.3 | 8.1891 | 490 |
| 500 | 1.1867 | 3486.6 | 8.3269 | 1.0468 | 3486.1 | 8.2688 | 0.936 31 | 3485.7 | 8.2170 | 500 |
| 510 | 1.2022 | 3508.0 | 8.3545 | 1.0605 | 3507.6 | 8.2964 | 0.948 56 | 3507.2 | 8.2446 | 510 |
| 520 | 1.2177 | 3529.5 | 8.3818 | 1.0741 | 3529.1 | 8.3237 | 0.960 80 | 3528.7 | 8.2720 | 520 |
| 530 | 1.2332 | 3551.1 | 8.4089 | 1.0878 | 3550.7 | 8.3507 | 0.973 04 | 3550.3 | 8.2990 | 530 |
| 540 | 1.2486 | 3572.8 | 8.4356 | 1.1015 | 3572.4 | 8.3775 | 0.985 28 | 3572.0 | 8.3258 | 540 |
| 550 | 1.2641 | 3594.5 | 8.4622 | 1.1151 | 3594.1 | 8.4041 | 0.997 51 | 3593.7 | 8.3524 | 550 |
| 560 | 1.2796 | 3616.2 | 8.4885 | 1.1288 | 3615.9 | 8.4304 | 1.0097 | 3615.5 | 8.3787 | 560 |
| 570 | 1.2950 | 3638.1 | 8.5145 | 1.1424 | 3637.7 | 8.4565 | 1.0220 | 3637.4 | 8.4048 | 570 |
| 580 | 1.3105 | 3660.0 | 8.5404 | 1.1561 | 3659.7 | 8.4823 | 1.0342 | 3659.3 | 8.4307 | 580 |
| 590 | 1.3260 | 3682.0 | 8.5660 | 1.1697 | 3681.7 | 8.5079 | 1.0464 | 3681.3 | 8.4563 | 590 |
| 600 | 1.3414 | 3704.0 | 8.5914 | 1.1834 | 3703.7 | 8.5333 | 1.0586 | 3703.4 | 8.4817 | 600 |
| 610 | 1.3569 | 3726.1 | 8.6165 | 1.1970 | 3725.8 | 8.5585 | 1.0708 | 3725.5 | 8.5069 | 610 |
| 620 | 1.3723 | 3748.3 | 8.6415 | 1.2107 | 3748.0 | 8.5835 | 1.0830 | 3747.7 | 8.5319 | 620 |
| 630 | 1.3877 | 3770.6 | 8.6663 | 1.2243 | 3770.3 | 8.6083 | 1.0952 | 3770.0 | 8.5567 | 630 |
| 640 | 1.4032 | 3792.9 | 8.6909 | 1.2379 | 3792.6 | 8.6329 | 1.1074 | 3792.3 | 8.5813 | 640 |
| 650 | 1.4186 | 3815.3 | 8.7152 | 1.2516 | 3815.0 | 8.6573 | 1.1196 | 3814.7 | 8.6057 | 650 |
| 660 | 1.4341 | 3837.7 | 8.7394 | 1.2652 | 3837.5 | 8.6815 | 1.1318 | 3837.2 | 8.6299 | 660 |
| 670 | 1.4495 | 3860.2 | 8.7634 | 1.2788 | 3860.0 | 8.7055 | 1.1440 | 3859.7 | 8.6539 | 670 |
| 680 | 1.4649 | 3882.8 | 8.7873 | 1.2924 | 3882.6 | 8.7293 | 1.1562 | 3882.3 | 8.6778 | 680 |
| 690 | 1.4804 | 3905.5 | 8.8109 | 1.3061 | 3905.2 | 8.7530 | 1.1684 | 3905.0 | 8.7014 | 690 |
| 700 | 1.4958 | 3928.2 | 8.8344 | 1.3197 | 3928.0 | 8.7764 | 1.1806 | 3927.7 | 8.7249 | 700 |
| 710 | 1.5112 | 3951.0 | 8.8577 | 1.3333 | 3950.8 | 8.7998 | 1.1928 | 3950.6 | 8.7482 | 710 |
| 720 | 1.5267 | 3973.9 | 8.8808 | 1.3469 | 3973.7 | 8.8229 | 1.2050 | 3973.4 | 8.7714 | 720 |
| 730 | 1.5421 | 3996.8 | 8.9038 | 1.3605 | 3996.6 | 8.8459 | 1.2172 | 3996.4 | 8.7944 | 730 |
| 740 | 1.5575 | 4019.8 | 8.9266 | 1.3742 | 4019.6 | 8.8687 | 1.2294 | 4019.4 | 8.8172 | 740 |
| 750 | 1.5729 | 4042.9 | 8.9493 | 1.3878 | 4042.7 | 8.8914 | 1.2416 | 4042.5 | 8.8399 | 750 |
| 760 | 1.5884 | 4066.0 | 8.9718 | 1.4014 | 4065.8 | 8.9139 | 1.2538 | 4065.6 | 8.8624 | 760 |
| 770 | 1.6038 | 4089.3 | 8.9942 | 1.4150 | 4089.1 | 8.9363 | 1.2659 | 4088.9 | 8.8848 | 770 |
| 780 | 1.6192 | 4112.5 | 9.0164 | 1.4286 | 4112.3 | 8.9585 | 1.2781 | 4112.2 | 8.9070 | 780 |
| 790 | 1.6346 | 4135.9 | 9.0385 | 1.4422 | 4135.7 | 8.9806 | 1.2903 | 4135.5 | 8.9291 | 790 |
| 800 | 1.6501 | 4159.3 | 9.0604 | 1.4558 | 4159.1 | 9.0025 | 1.3025 | 4159.0 | 8.9510 | 800 |

**UNITS**: $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 0.42 MPa ($t_{sat}$ = 145.38 °C) | | | 0.46 MPa ($t_{sat}$ = 148.72 °C) | | | 0.50 MPa ($t_{sat}$ = 151.84 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| Sat. Liq. | 0.001 085 5 | 612.33 | 1.7948 | 0.001 089 1 | 626.73 | 1.8289 | 0.001 092 6 | 640.19 | 1.8606 | Sat. Liq. |
| Sat. Vap. | 0.441 66 | 2740.3 | 6.8791 | 0.405 43 | 2744.4 | 6.8486 | 0.374 80 | 2748.1 | 6.8206 | Sat. Vap. |
| 0 | 0.001 000 0 | 0.39 | -0.0001 | 0.001 000 0 | 0.43 | -0.0001 | 0.001 000 0 | 0.47 | -0.0001 | 0 |
| 5 | 0.000 999 9 | 21.44 | 0.0762 | 0.000 999 9 | 21.48 | 0.0762 | 0.000 999 8 | 21.52 | 0.0762 | 5 |
| 10 | 0.001 000 1 | 42.43 | 0.1510 | 0.001 000 1 | 42.47 | 0.1510 | 0.001 000 1 | 42.51 | 0.1510 | 10 |
| 15 | 0.001 000 8 | 63.38 | 0.2244 | 0.001 000 7 | 63.42 | 0.2244 | 0.001 000 7 | 63.46 | 0.2244 | 15 |
| 20 | 0.001 001 7 | 84.31 | 0.2964 | 0.001 001 6 | 84.35 | 0.2964 | 0.001 001 6 | 84.39 | 0.2964 | 20 |
| 25 | 0.001 002 8 | 105.22 | 0.3671 | 0.001 002 8 | 105.26 | 0.3671 | 0.001 002 8 | 105.30 | 0.3671 | 25 |
| 30 | 0.001 004 2 | 126.12 | 0.4367 | 0.001 004 2 | 126.16 | 0.4367 | 0.001 004 2 | 126.20 | 0.4366 | 30 |
| 35 | 0.001 005 9 | 147.02 | 0.5050 | 0.001 005 8 | 147.05 | 0.5050 | 0.001 005 8 | 147.09 | 0.5050 | 35 |
| 40 | 0.001 007 7 | 167.91 | 0.5723 | 0.001 007 7 | 167.94 | 0.5723 | 0.001 007 7 | 167.98 | 0.5722 | 40 |
| 45 | 0.001 009 7 | 188.80 | 0.6384 | 0.001 009 7 | 188.83 | 0.6384 | 0.001 009 7 | 188.87 | 0.6384 | 45 |
| 50 | 0.001 012 0 | 209.69 | 0.7036 | 0.001 011 9 | 209.72 | 0.7036 | 0.001 011 9 | 209.76 | 0.7036 | 50 |
| 55 | 0.001 014 4 | 230.59 | 0.7678 | 0.001 014 3 | 230.62 | 0.7678 | 0.001 014 3 | 230.65 | 0.7677 | 55 |
| 60 | 0.001 016 9 | 251.49 | 0.8310 | 0.001 016 9 | 251.52 | 0.8310 | 0.001 016 9 | 251.56 | 0.8310 | 60 |
| 65 | 0.001 019 7 | 272.41 | 0.8933 | 0.001 019 7 | 272.44 | 0.8933 | 0.001 019 6 | 272.47 | 0.8933 | 65 |
| 70 | 0.001 022 6 | 293.34 | 0.9548 | 0.001 022 6 | 293.37 | 0.9547 | 0.001 022 5 | 293.40 | 0.9547 | 70 |
| 75 | 0.001 025 6 | 314.28 | 1.0154 | 0.001 025 6 | 314.31 | 1.0153 | 0.001 025 6 | 314.35 | 1.0153 | 75 |
| 80 | 0.001 028 9 | 335.25 | 1.0751 | 0.001 028 8 | 335.28 | 1.0751 | 0.001 028 8 | 335.31 | 1.0751 | 80 |
| 85 | 0.001 032 2 | 356.23 | 1.1342 | 0.001 032 2 | 356.26 | 1.1341 | 0.001 032 2 | 356.29 | 1.1341 | 85 |
| 90 | 0.001 035 8 | 377.24 | 1.1924 | 0.001 035 8 | 377.27 | 1.1924 | 0.001 035 7 | 377.30 | 1.1923 | 90 |
| 95 | 0.001 039 5 | 398.27 | 1.2499 | 0.001 039 4 | 398.30 | 1.2499 | 0.001 039 4 | 398.34 | 1.2499 | 95 |
| 100 | 0.001 043 3 | 419.34 | 1.3068 | 0.001 043 3 | 419.37 | 1.3067 | 0.001 043 3 | 419.40 | 1.3067 | 100 |
| 105 | 0.001 047 3 | 440.43 | 1.3629 | 0.001 047 3 | 440.46 | 1.3629 | 0.001 047 2 | 440.49 | 1.3629 | 105 |
| 110 | 0.001 051 4 | 461.56 | 1.4184 | 0.001 051 4 | 461.59 | 1.4184 | 0.001 051 4 | 461.62 | 1.4184 | 110 |
| 115 | 0.001 055 7 | 482.73 | 1.4733 | 0.001 055 7 | 482.76 | 1.4733 | 0.001 055 7 | 482.79 | 1.4733 | 115 |
| 120 | 0.001 060 2 | 503.94 | 1.5276 | 0.001 060 2 | 503.97 | 1.5276 | 0.001 060 2 | 504.00 | 1.5275 | 120 |
| 125 | 0.001 064 8 | 525.19 | 1.5813 | 0.001 064 8 | 525.22 | 1.5813 | 0.001 064 8 | 525.25 | 1.5813 | 125 |
| 130 | 0.001 069 6 | 546.49 | 1.6345 | 0.001 069 6 | 546.52 | 1.6344 | 0.001 069 6 | 546.54 | 1.6344 | 130 |
| 135 | 0.001 074 6 | 567.84 | 1.6871 | 0.001 074 6 | 567.86 | 1.6871 | 0.001 074 5 | 567.89 | 1.6870 | 135 |
| 140 | 0.001 079 7 | 589.24 | 1.7392 | 0.001 079 7 | 589.26 | 1.7392 | 0.001 079 7 | 589.29 | 1.7391 | 140 |
| 145 | 0.001 085 0 | 610.70 | 1.7909 | 0.001 085 0 | 610.72 | 1.7908 | 0.001 085 0 | 610.75 | 1.7908 | 145 |
| 150 | 0.447 55 | 2751.0 | 6.9046 | 0.406 94 | 2747.4 | 6.8558 | 0.001 090 5 | 632.27 | 1.8419 | 150 |
| 155 | 0.453 85 | 2762.4 | 6.9314 | 0.412 79 | 2759.1 | 6.8832 | 0.378 26 | 2755.7 | 6.8383 | 155 |
| 160 | 0.460 07 | 2773.7 | 6.9575 | 0.418 56 | 2770.6 | 6.9098 | 0.383 66 | 2767.4 | 6.8655 | 160 |
| 165 | 0.466 24 | 2784.8 | 6.9830 | 0.424 27 | 2781.8 | 6.9357 | 0.388 99 | 2778.9 | 6.8919 | 165 |
| 170 | 0.472 36 | 2795.7 | 7.0079 | 0.429 92 | 2793.0 | 6.9610 | 0.394 25 | 2790.2 | 6.9176 | 170 |
| 175 | 0.478 44 | 2806.6 | 7.0323 | 0.435 53 | 2804.0 | 6.9858 | 0.399 48 | 2801.4 | 6.9427 | 175 |
| 180 | 0.484 48 | 2817.4 | 7.0563 | 0.441 11 | 2815.0 | 7.0100 | 0.404 66 | 2812.4 | 6.9672 | 180 |
| 185 | 0.490 49 | 2828.1 | 7.0798 | 0.446 64 | 2825.8 | 7.0339 | 0.409 80 | 2823.4 | 6.9913 | 185 |
| 190 | 0.496 46 | 2838.8 | 7.1030 | 0.452 14 | 2836.6 | 7.0573 | 0.414 91 | 2834.3 | 7.0150 | 190 |
| 195 | 0.502 40 | 2849.4 | 7.1258 | 0.457 62 | 2847.3 | 7.0803 | 0.419 98 | 2845.1 | 7.0382 | 195 |
| 200 | 0.508 32 | 2860.0 | 7.1482 | 0.463 06 | 2858.0 | 7.1029 | 0.425 03 | 2855.9 | 7.0611 | 200 |
| 205 | 0.514 22 | 2870.5 | 7.1703 | 0.468 48 | 2868.6 | 7.1252 | 0.430 06 | 2866.6 | 7.0836 | 205 |
| 210 | 0.520 09 | 2881.0 | 7.1921 | 0.473 88 | 2879.1 | 7.1472 | 0.435 06 | 2877.2 | 7.1057 | 210 |
| 215 | 0.525 94 | 2891.4 | 7.2136 | 0.479 26 | 2889.6 | 7.1688 | 0.440 04 | 2887.8 | 7.1275 | 215 |
| 220 | 0.531 77 | 2901.8 | 7.2348 | 0.484 62 | 2900.1 | 7.1902 | 0.445 00 | 2898.4 | 7.1491 | 220 |
| 225 | 0.537 59 | 2912.2 | 7.2558 | 0.489 96 | 2910.6 | 7.2113 | 0.449 94 | 2908.9 | 7.1703 | 225 |
| 230 | 0.543 39 | 2922.6 | 7.2765 | 0.495 28 | 2921.0 | 7.2321 | 0.454 87 | 2919.4 | 7.1912 | 230 |
| 235 | 0.549 17 | 2932.9 | 7.2970 | 0.500 59 | 2931.4 | 7.2527 | 0.459 78 | 2929.9 | 7.2119 | 235 |
| 240 | 0.554 94 | 2943.3 | 7.3172 | 0.505 89 | 2941.8 | 7.2730 | 0.464 68 | 2940.3 | 7.2324 | 240 |
| 245 | 0.560 70 | 2953.6 | 7.3372 | 0.511 17 | 2952.2 | 7.2931 | 0.469 56 | 2950.7 | 7.2526 | 245 |
| 250 | 0.566 45 | 2963.9 | 7.3570 | 0.516 44 | 2962.5 | 7.3130 | 0.474 43 | 2961.1 | 7.2726 | 250 |
| 255 | 0.572 18 | 2974.2 | 7.3766 | 0.521 70 | 2972.8 | 7.3327 | 0.479 29 | 2971.5 | 7.2923 | 255 |
| 260 | 0.577 90 | 2984.5 | 7.3959 | 0.526 94 | 2983.2 | 7.3521 | 0.484 14 | 2981.9 | 7.3119 | 260 |
| 265 | 0.583 62 | 2994.7 | 7.4151 | 0.532 18 | 2993.5 | 7.3714 | 0.488 97 | 2992.2 | 7.3312 | 265 |
| 270 | 0.589 32 | 3005.0 | 7.4341 | 0.537 41 | 3003.8 | 7.3905 | 0.493 80 | 3002.6 | 7.3503 | 270 |

**UNITS**: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.42 MPa ($t_{sat}$ = 145.38 °C) | | | 0.46 MPa ($t_{sat}$ = 148.72 °C) | | | 0.50 MPa ($t_{sat}$ = 151.84 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 0.595 02 | 3015.3 | 7.4529 | 0.542 63 | 3014.1 | 7.4094 | 0.498 62 | 3012.9 | 7.3693 | 275 |
| 280 | 0.600 71 | 3025.5 | 7.4716 | 0.547 84 | 3024.4 | 7.4281 | 0.503 43 | 3023.3 | 7.3881 | 280 |
| 285 | 0.606 39 | 3035.8 | 7.4901 | 0.553 05 | 3034.7 | 7.4466 | 0.508 24 | 3033.6 | 7.4067 | 285 |
| 290 | 0.612 06 | 3046.1 | 7.5084 | 0.558 24 | 3045.0 | 7.4650 | 0.513 03 | 3043.9 | 7.4251 | 290 |
| 295 | 0.617 73 | 3056.3 | 7.5265 | 0.563 43 | 3055.3 | 7.4832 | 0.517 82 | 3054.3 | 7.4433 | 295 |
| 300 | 0.623 39 | 3066.6 | 7.5445 | 0.568 61 | 3065.6 | 7.5012 | 0.522 60 | 3064.6 | 7.4614 | 300 |
| 310 | 0.634 69 | 3087.2 | 7.5801 | 0.578 96 | 3086.2 | 7.5369 | 0.532 15 | 3085.3 | 7.4972 | 310 |
| 320 | 0.645 97 | 3107.7 | 7.6151 | 0.589 29 | 3106.8 | 7.5719 | 0.541 67 | 3105.9 | 7.5323 | 320 |
| 330 | 0.657 23 | 3128.3 | 7.6495 | 0.599 60 | 3127.5 | 7.6065 | 0.551 18 | 3126.6 | 7.5669 | 330 |
| 340 | 0.668 48 | 3149.0 | 7.6834 | 0.609 89 | 3148.1 | 7.6404 | 0.560 67 | 3147.3 | 7.6010 | 340 |
| 350 | 0.679 71 | 3169.6 | 7.7168 | 0.620 16 | 3168.8 | 7.6739 | 0.570 14 | 3168.1 | 7.6345 | 350 |
| 360 | 0.690 92 | 3190.3 | 7.7498 | 0.630 42 | 3189.6 | 7.7069 | 0.579 59 | 3188.8 | 7.6676 | 360 |
| 370 | 0.702 12 | 3211.1 | 7.7823 | 0.640 66 | 3210.3 | 7.7395 | 0.589 04 | 3209.6 | 7.7002 | 370 |
| 380 | 0.713 31 | 3231.8 | 7.8144 | 0.650 89 | 3231.2 | 7.7716 | 0.598 47 | 3230.5 | 7.7323 | 380 |
| 390 | 0.724 48 | 3252.7 | 7.8460 | 0.661 12 | 3252.0 | 7.8033 | 0.607 89 | 3251.4 | 7.7641 | 390 |
| 400 | 0.735 65 | 3273.5 | 7.8773 | 0.671 33 | 3272.9 | 7.8346 | 0.617 29 | 3272.3 | 7.7954 | 400 |
| 410 | 0.746 81 | 3294.5 | 7.9081 | 0.681 53 | 3293.9 | 7.8655 | 0.626 69 | 3293.3 | 7.8263 | 410 |
| 420 | 0.757 96 | 3315.4 | 7.9386 | 0.691 72 | 3314.9 | 7.8960 | 0.636 08 | 3314.3 | 7.8569 | 420 |
| 430 | 0.769 09 | 3336.5 | 7.9687 | 0.701 90 | 3335.9 | 7.9261 | 0.645 46 | 3335.4 | 7.8871 | 430 |
| 440 | 0.780 23 | 3357.6 | 7.9985 | 0.712 08 | 3357.0 | 7.9559 | 0.654 84 | 3356.5 | 7.9169 | 440 |
| 450 | 0.791 35 | 3378.7 | 8.0279 | 0.722 25 | 3378.2 | 7.9854 | 0.664 21 | 3377.7 | 7.9464 | 450 |
| 460 | 0.802 47 | 3399.9 | 8.0570 | 0.732 41 | 3399.4 | 8.0145 | 0.673 57 | 3398.9 | 7.9756 | 460 |
| 470 | 0.813 58 | 3421.2 | 8.0858 | 0.742 57 | 3420.7 | 8.0434 | 0.682 92 | 3420.2 | 8.0044 | 470 |
| 480 | 0.824 69 | 3442.5 | 8.1143 | 0.752 72 | 3442.0 | 8.0719 | 0.692 27 | 3441.5 | 8.0329 | 480 |
| 490 | 0.835 79 | 3463.8 | 8.1425 | 0.762 86 | 3463.4 | 8.1001 | 0.701 61 | 3462.9 | 8.0612 | 490 |
| 500 | 0.846 88 | 3485.3 | 8.1704 | 0.773 00 | 3484.8 | 8.1280 | 0.710 95 | 3484.4 | 8.0891 | 500 |
| 510 | 0.857 97 | 3506.8 | 8.1980 | 0.783 14 | 3506.3 | 8.1556 | 0.720 28 | 3505.9 | 8.1168 | 510 |
| 520 | 0.869 06 | 3528.3 | 8.2254 | 0.793 27 | 3527.9 | 8.1830 | 0.729 61 | 3527.5 | 8.1442 | 520 |
| 530 | 0.880 14 | 3549.9 | 8.2525 | 0.803 40 | 3549.6 | 8.2101 | 0.738 93 | 3549.2 | 8.1713 | 530 |
| 540 | 0.891 22 | 3571.6 | 8.2793 | 0.813 52 | 3571.2 | 8.2370 | 0.748 25 | 3570.9 | 8.1981 | 540 |
| 550 | 0.902 29 | 3593.4 | 8.3059 | 0.823 64 | 3593.0 | 8.2636 | 0.757 57 | 3592.6 | 8.2247 | 550 |
| 560 | 0.913 36 | 3615.2 | 8.3322 | 0.833 75 | 3614.8 | 8.2899 | 0.766 88 | 3614.5 | 8.2511 | 560 |
| 570 | 0.924 43 | 3637.1 | 8.3583 | 0.843 86 | 3636.7 | 8.3160 | 0.776 19 | 3636.4 | 8.2772 | 570 |
| 580 | 0.935 49 | 3659.0 | 8.3842 | 0.853 97 | 3658.7 | 8.3419 | 0.785 49 | 3658.3 | 8.3031 | 580 |
| 590 | 0.946 55 | 3681.0 | 8.4098 | 0.864 08 | 3680.7 | 8.3676 | 0.794 80 | 3680.4 | 8.3288 | 590 |
| 600 | 0.957 61 | 3703.1 | 8.4353 | 0.874 18 | 3702.8 | 8.3930 | 0.804 10 | 3702.5 | 8.3543 | 600 |
| 610 | 0.968 67 | 3725.2 | 8.4605 | 0.884 28 | 3724.9 | 8.4182 | 0.813 39 | 3724.6 | 8.3795 | 610 |
| 620 | 0.979 72 | 3747.4 | 8.4855 | 0.894 38 | 3747.1 | 8.4432 | 0.822 69 | 3746.8 | 8.4045 | 620 |
| 630 | 0.990 77 | 3769.7 | 8.5103 | 0.904 47 | 3769.4 | 8.4681 | 0.831 98 | 3769.1 | 8.4293 | 630 |
| 640 | 1.0018 | 3792.0 | 8.5349 | 0.914 56 | 3791.8 | 8.4927 | 0.841 27 | 3791.5 | 8.4539 | 640 |
| 650 | 1.0129 | 3814.5 | 8.5593 | 0.924 65 | 3814.2 | 8.5171 | 0.850 56 | 3813.9 | 8.4784 | 650 |
| 660 | 1.0239 | 3836.9 | 8.5835 | 0.934 74 | 3836.7 | 8.5413 | 0.859 84 | 3836.4 | 8.5026 | 660 |
| 670 | 1.0349 | 3859.5 | 8.6075 | 0.944 83 | 3859.2 | 8.5653 | 0.869 12 | 3859.0 | 8.5266 | 670 |
| 680 | 1.0460 | 3882.1 | 8.6314 | 0.954 91 | 3881.8 | 8.5892 | 0.878 41 | 3881.6 | 8.5505 | 680 |
| 690 | 1.0570 | 3904.8 | 8.6551 | 0.964 99 | 3904.5 | 8.6129 | 0.887 69 | 3904.3 | 8.5742 | 690 |
| 700 | 1.0681 | 3927.5 | 8.6785 | 0.975 07 | 3927.3 | 8.6364 | 0.896 96 | 3927.0 | 8.5977 | 700 |
| 710 | 1.0791 | 3950.3 | 8.7019 | 0.985 15 | 3950.1 | 8.6597 | 0.906 24 | 3949.9 | 8.6210 | 710 |
| 720 | 1.0901 | 3973.2 | 8.7250 | 0.995 23 | 3973.0 | 8.6829 | 0.915 52 | 3972.8 | 8.6442 | 720 |
| 730 | 1.1012 | 3996.2 | 8.7480 | 1.0053 | 3996.0 | 8.7059 | 0.924 79 | 3995.7 | 8.6672 | 730 |
| 740 | 1.1122 | 4019.2 | 8.7709 | 1.0154 | 4019.0 | 8.7287 | 0.934 06 | 4018.8 | 8.6901 | 740 |
| 750 | 1.1232 | 4042.3 | 8.7935 | 1.0255 | 4042.1 | 8.7514 | 0.943 33 | 4041.9 | 8.7128 | 750 |
| 760 | 1.1342 | 4065.4 | 8.8161 | 1.0355 | 4065.2 | 8.7739 | 0.952 60 | 4065.0 | 8.7353 | 760 |
| 770 | 1.1453 | 4088.7 | 8.8384 | 1.0456 | 4088.5 | 8.7963 | 0.961 87 | 4088.3 | 8.7577 | 770 |
| 780 | 1.1563 | 4112.0 | 8.8607 | 1.0557 | 4111.8 | 8.8185 | 0.971 14 | 4111.6 | 8.7799 | 780 |
| 790 | 1.1673 | 4135.3 | 8.8828 | 1.0657 | 4135.1 | 8.8406 | 0.980 40 | 4135.0 | 8.8020 | 790 |
| 800 | 1.1784 | 4158.8 | 8.9047 | 1.0758 | 4158.6 | 8.8626 | 0.989 67 | 4158.4 | 8.8240 | 800 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.55 MPa ($t_{sat}$ = 155.46 °C) | | | 0.60 MPa ($t_{sat}$ = 158.83 °C) | | | 0.65 MPa ($t_{sat}$ = 161.99 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 096 7 | 655.88 | 1.8972 | 0.001 100 6 | 670.50 | 1.9311 | 0.001 104 4 | 684.22 | 1.9626 | Sat. Liq. |
| Sat. Vap. | 0.342 59 | 2752.3 | 6.7885 | 0.315 58 | 2756.1 | 6.7592 | 0.292 58 | 2759.6 | 6.7321 | Sat. Vap. |
| 0 | 0.000 999 9 | 0.52 | -0.0001 | 0.000 999 9 | 0.57 | -0.0001 | 0.000 999 9 | 0.62 | -0.0001 | 0 |
| 5 | 0.000 999 8 | 21.57 | 0.0762 | 0.000 999 8 | 21.62 | 0.0762 | 0.000 999 8 | 21.67 | 0.0762 | 5 |
| 10 | 0.001 000 1 | 42.56 | 0.1510 | 0.001 000 1 | 42.60 | 0.1510 | 0.001 000 0 | 42.65 | 0.1510 | 10 |
| 15 | 0.001 000 7 | 63.51 | 0.2244 | 0.001 000 7 | 63.56 | 0.2244 | 0.001 000 6 | 63.60 | 0.2244 | 15 |
| 20 | 0.001 001 6 | 84.44 | 0.2964 | 0.001 001 6 | 84.48 | 0.2964 | 0.001 001 5 | 84.53 | 0.2964 | 20 |
| 25 | 0.001 002 8 | 105.34 | 0.3671 | 0.001 002 7 | 105.39 | 0.3671 | 0.001 002 7 | 105.44 | 0.3671 | 25 |
| 30 | 0.001 004 2 | 126.24 | 0.4366 | 0.001 004 1 | 126.29 | 0.4366 | 0.001 004 1 | 126.33 | 0.4366 | 30 |
| 35 | 0.001 005 8 | 147.13 | 0.5050 | 0.001 005 8 | 147.18 | 0.5050 | 0.001 005 8 | 147.22 | 0.5049 | 35 |
| 40 | 0.001 007 6 | 168.02 | 0.5722 | 0.001 007 6 | 168.07 | 0.5722 | 0.001 007 6 | 168.11 | 0.5722 | 40 |
| 45 | 0.001 009 7 | 188.91 | 0.6384 | 0.001 009 7 | 188.95 | 0.6384 | 0.001 009 6 | 189.00 | 0.6384 | 45 |
| 50 | 0.001 011 9 | 209.80 | 0.7035 | 0.001 011 9 | 209.84 | 0.7035 | 0.001 011 9 | 209.89 | 0.7035 | 50 |
| 55 | 0.001 014 3 | 230.70 | 0.7677 | 0.001 014 3 | 230.74 | 0.7677 | 0.001 014 3 | 230.78 | 0.7677 | 55 |
| 60 | 0.001 016 9 | 251.60 | 0.8309 | 0.001 016 9 | 251.64 | 0.8309 | 0.001 016 8 | 251.68 | 0.8309 | 60 |
| 65 | 0.001 019 6 | 272.51 | 0.8932 | 0.001 019 6 | 272.56 | 0.8932 | 0.001 019 6 | 272.60 | 0.8932 | 65 |
| 70 | 0.001 022 5 | 293.44 | 0.9547 | 0.001 022 5 | 293.48 | 0.9547 | 0.001 022 5 | 293.52 | 0.9546 | 70 |
| 75 | 0.001 025 6 | 314.39 | 1.0153 | 0.001 025 6 | 314.43 | 1.0152 | 0.001 025 5 | 314.47 | 1.0152 | 75 |
| 80 | 0.001 028 8 | 335.35 | 1.0751 | 0.001 028 8 | 335.39 | 1.0750 | 0.001 028 8 | 335.43 | 1.0750 | 80 |
| 85 | 0.001 032 2 | 356.33 | 1.1341 | 0.001 032 2 | 356.37 | 1.1340 | 0.001 032 1 | 356.41 | 1.1340 | 85 |
| 90 | 0.001 035 7 | 377.34 | 1.1923 | 0.001 035 7 | 377.38 | 1.1923 | 0.001 035 7 | 377.42 | 1.1922 | 90 |
| 95 | 0.001 039 4 | 398.37 | 1.2498 | 0.001 039 4 | 398.41 | 1.2498 | 0.001 039 3 | 398.45 | 1.2498 | 95 |
| 100 | 0.001 043 2 | 419.44 | 1.3067 | 0.001 043 2 | 419.47 | 1.3066 | 0.001 043 2 | 419.51 | 1.3066 | 100 |
| 105 | 0.001 047 2 | 440.53 | 1.3628 | 0.001 047 2 | 440.57 | 1.3628 | 0.001 047 2 | 440.60 | 1.3627 | 105 |
| 110 | 0.001 051 4 | 461.66 | 1.4183 | 0.001 051 3 | 461.70 | 1.4183 | 0.001 051 3 | 461.73 | 1.4182 | 110 |
| 115 | 0.001 055 7 | 482.83 | 1.4732 | 0.001 055 6 | 482.86 | 1.4732 | 0.001 055 6 | 482.90 | 1.4731 | 115 |
| 120 | 0.001 060 1 | 504.03 | 1.5275 | 0.001 060 1 | 504.07 | 1.5275 | 0.001 060 1 | 504.10 | 1.5274 | 120 |
| 125 | 0.001 064 8 | 525.28 | 1.5812 | 0.001 064 7 | 525.32 | 1.5812 | 0.001 064 7 | 525.35 | 1.5811 | 125 |
| 130 | 0.001 069 5 | 546.58 | 1.6344 | 0.001 069 5 | 546.61 | 1.6343 | 0.001 069 5 | 546.64 | 1.6343 | 130 |
| 135 | 0.001 074 5 | 567.92 | 1.6870 | 0.001 074 5 | 567.96 | 1.6869 | 0.001 074 4 | 567.99 | 1.6869 | 135 |
| 140 | 0.001 079 6 | 589.32 | 1.7391 | 0.001 079 6 | 589.35 | 1.7390 | 0.001 079 6 | 589.39 | 1.7390 | 140 |
| 145 | 0.001 085 0 | 610.78 | 1.7907 | 0.001 084 9 | 610.81 | 1.7907 | 0.001 084 9 | 610.84 | 1.7906 | 145 |
| 150 | 0.001 090 5 | 632.30 | 1.8419 | 0.001 090 4 | 632.33 | 1.8418 | 0.001 090 4 | 632.36 | 1.8418 | 150 |
| 155 | 0.001 096 1 | 653.88 | 1.8926 | 0.001 096 1 | 653.91 | 1.8925 | 0.001 096 1 | 653.94 | 1.8925 | 155 |
| 160 | 0.347 14 | 2763.3 | 6.8139 | 0.316 67 | 2759.0 | 6.7658 | 0.001 102 0 | 675.59 | 1.9427 | 160 |
| 165 | 0.352 07 | 2775.1 | 6.8410 | 0.321 28 | 2771.1 | 6.7936 | 0.295 20 | 2767.1 | 6.7493 | 165 |
| 170 | 0.356 94 | 2786.6 | 6.8672 | 0.325 82 | 2783.0 | 6.8205 | 0.299 47 | 2779.2 | 6.7768 | 170 |
| 175 | 0.361 76 | 2798.0 | 6.8928 | 0.330 31 | 2794.6 | 6.8466 | 0.303 68 | 2791.1 | 6.8034 | 175 |
| 180 | 0.366 53 | 2809.3 | 6.9177 | 0.334 74 | 2806.0 | 6.8720 | 0.307 83 | 2802.7 | 6.8293 | 180 |
| 185 | 0.371 26 | 2820.4 | 6.9422 | 0.339 14 | 2817.4 | 6.8968 | 0.311 94 | 2814.2 | 6.8545 | 185 |
| 190 | 0.375 96 | 2831.5 | 6.9662 | 0.343 50 | 2828.6 | 6.9211 | 0.316 01 | 2825.6 | 6.8792 | 190 |
| 195 | 0.380 63 | 2842.4 | 6.9897 | 0.347 82 | 2839.7 | 6.9450 | 0.320 05 | 2836.8 | 6.9033 | 195 |
| 200 | 0.385 27 | 2853.3 | 7.0128 | 0.352 12 | 2850.7 | 6.9684 | 0.324 06 | 2848.0 | 6.9270 | 200 |
| 205 | 0.389 88 | 2864.1 | 7.0356 | 0.356 38 | 2861.6 | 6.9913 | 0.328 03 | 2859.1 | 6.9503 | 205 |
| 210 | 0.394 47 | 2874.9 | 7.0579 | 0.360 63 | 2872.5 | 7.0139 | 0.331 99 | 2870.0 | 6.9731 | 210 |
| 215 | 0.399 03 | 2885.6 | 7.0800 | 0.364 85 | 2883.3 | 7.0362 | 0.335 92 | 2880.9 | 6.9956 | 215 |
| 220 | 0.403 58 | 2896.2 | 7.1017 | 0.369 05 | 2894.0 | 7.0581 | 0.339 83 | 2891.8 | 7.0177 | 220 |
| 225 | 0.408 10 | 2906.8 | 7.1231 | 0.373 23 | 2904.7 | 7.0797 | 0.343 72 | 2902.6 | 7.0395 | 225 |
| 230 | 0.412 61 | 2917.4 | 7.1442 | 0.377 39 | 2915.4 | 7.1010 | 0.347 59 | 2913.3 | 7.0609 | 230 |
| 235 | 0.417 11 | 2927.9 | 7.1651 | 0.381 54 | 2926.0 | 7.1220 | 0.351 44 | 2924.0 | 7.0821 | 235 |
| 240 | 0.421 59 | 2938.4 | 7.1856 | 0.385 67 | 2936.6 | 7.1427 | 0.355 28 | 2934.7 | 7.1029 | 240 |
| 245 | 0.426 05 | 2948.9 | 7.2060 | 0.389 79 | 2947.1 | 7.1632 | 0.359 11 | 2945.3 | 7.1235 | 245 |
| 250 | 0.430 51 | 2959.4 | 7.2261 | 0.393 90 | 2957.7 | 7.1834 | 0.362 92 | 2955.9 | 7.1439 | 250 |
| 255 | 0.434 95 | 2969.8 | 7.2459 | 0.397 99 | 2968.2 | 7.2034 | 0.366 72 | 2966.5 | 7.1640 | 255 |
| 260 | 0.439 38 | 2980.3 | 7.2656 | 0.402 07 | 2978.6 | 7.2231 | 0.370 51 | 2977.0 | 7.1839 | 260 |
| 265 | 0.443 80 | 2990.7 | 7.2850 | 0.406 15 | 2989.1 | 7.2427 | 0.374 29 | 2987.5 | 7.2035 | 265 |
| 270 | 0.448 21 | 3001.1 | 7.3043 | 0.410 21 | 2999.6 | 7.2620 | 0.378 05 | 2998.0 | 7.2229 | 270 |

**UNITS**: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.55 MPa ($t_{sat}$ = 155.46 °C) | | | 0.60 MPa ($t_{sat}$ = 158.83 °C) | | | 0.65 MPa ($t_{sat}$ = 161.99 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 0.452 61 | 3011.5 | 7.3233 | 0.414 26 | 3010.0 | 7.2811 | 0.381 81 | 3008.5 | 7.2421 | 275 |
| 280 | 0.457 00 | 3021.9 | 7.3422 | 0.418 31 | 3020.4 | 7.3001 | 0.385 56 | 3019.0 | 7.2612 | 280 |
| 285 | 0.461 39 | 3032.2 | 7.3608 | 0.422 34 | 3030.8 | 7.3188 | 0.389 30 | 3029.4 | 7.2800 | 285 |
| 290 | 0.465 76 | 3042.6 | 7.3793 | 0.426 37 | 3041.3 | 7.3374 | 0.393 04 | 3039.9 | 7.2986 | 290 |
| 295 | 0.470 13 | 3053.0 | 7.3977 | 0.430 39 | 3051.7 | 7.3558 | 0.396 77 | 3050.3 | 7.3171 | 295 |
| 300 | 0.474 50 | 3063.3 | 7.4158 | 0.434 41 | 3062.1 | 7.3740 | 0.400 49 | 3060.8 | 7.3354 | 300 |
| 310 | 0.483 21 | 3084.1 | 7.4517 | 0.442 42 | 3082.9 | 7.4100 | 0.407 91 | 3081.6 | 7.3715 | 310 |
| 320 | 0.491 89 | 3104.8 | 7.4869 | 0.450 41 | 3103.7 | 7.4453 | 0.415 31 | 3102.5 | 7.4070 | 320 |
| 330 | 0.500 56 | 3125.5 | 7.5216 | 0.458 38 | 3124.5 | 7.4801 | 0.422 68 | 3123.4 | 7.4418 | 330 |
| 340 | 0.509 21 | 3146.3 | 7.5557 | 0.466 33 | 3145.3 | 7.5143 | 0.430 04 | 3144.2 | 7.4761 | 340 |
| 350 | 0.517 84 | 3167.1 | 7.5894 | 0.474 26 | 3166.1 | 7.5480 | 0.437 39 | 3165.1 | 7.5099 | 350 |
| 360 | 0.526 46 | 3187.9 | 7.6225 | 0.482 18 | 3187.0 | 7.5812 | 0.444 71 | 3186.0 | 7.5432 | 360 |
| 370 | 0.535 06 | 3208.7 | 7.6552 | 0.490 09 | 3207.8 | 7.6140 | 0.452 03 | 3206.9 | 7.5760 | 370 |
| 380 | 0.543 66 | 3229.6 | 7.6874 | 0.497 98 | 3228.8 | 7.6463 | 0.459 33 | 3227.9 | 7.6083 | 380 |
| 390 | 0.552 24 | 3250.5 | 7.7192 | 0.505 86 | 3249.7 | 7.6781 | 0.466 62 | 3248.9 | 7.6402 | 390 |
| 400 | 0.560 81 | 3271.5 | 7.7505 | 0.513 73 | 3270.7 | 7.7095 | 0.473 90 | 3269.9 | 7.6717 | 400 |
| 410 | 0.569 37 | 3292.5 | 7.7815 | 0.521 59 | 3291.8 | 7.7405 | 0.481 17 | 3291.0 | 7.7028 | 410 |
| 420 | 0.577 92 | 3313.6 | 7.8121 | 0.529 44 | 3312.8 | 7.7712 | 0.488 43 | 3312.1 | 7.7335 | 420 |
| 430 | 0.586 46 | 3334.7 | 7.8423 | 0.537 29 | 3334.0 | 7.8014 | 0.495 68 | 3333.3 | 7.7638 | 430 |
| 440 | 0.594 99 | 3355.8 | 7.8722 | 0.545 12 | 3355.1 | 7.8314 | 0.502 92 | 3354.5 | 7.7937 | 440 |
| 450 | 0.603 52 | 3377.0 | 7.9017 | 0.552 95 | 3376.4 | 7.8609 | 0.510 16 | 3375.7 | 7.8233 | 450 |
| 460 | 0.612 04 | 3398.3 | 7.9309 | 0.560 77 | 3397.7 | 7.8901 | 0.517 39 | 3397.0 | 7.8526 | 460 |
| 470 | 0.620 56 | 3419.6 | 7.9598 | 0.568 59 | 3419.0 | 7.9190 | 0.524 62 | 3418.4 | 7.8815 | 470 |
| 480 | 0.629 07 | 3441.0 | 7.9884 | 0.576 40 | 3440.4 | 7.9476 | 0.531 83 | 3439.8 | 7.9101 | 480 |
| 490 | 0.637 57 | 3462.4 | 8.0166 | 0.584 20 | 3461.8 | 7.9759 | 0.539 05 | 3461.3 | 7.9384 | 490 |
| 500 | 0.646 07 | 3483.9 | 8.0446 | 0.592 00 | 3483.3 | 8.0039 | 0.546 25 | 3482.8 | 7.9665 | 500 |
| 510 | 0.654 56 | 3505.4 | 8.0723 | 0.599 80 | 3504.9 | 8.0316 | 0.553 46 | 3504.4 | 7.9942 | 510 |
| 520 | 0.663 05 | 3527.0 | 8.0997 | 0.607 59 | 3526.5 | 8.0591 | 0.560 65 | 3526.0 | 8.0216 | 520 |
| 530 | 0.671 53 | 3548.7 | 8.1268 | 0.615 37 | 3548.2 | 8.0862 | 0.567 85 | 3547.7 | 8.0488 | 530 |
| 540 | 0.680 02 | 3570.4 | 8.1537 | 0.623 15 | 3569.9 | 8.1131 | 0.575 04 | 3569.5 | 8.0757 | 540 |
| 550 | 0.688 49 | 3592.2 | 8.1803 | 0.630 93 | 3591.7 | 8.1398 | 0.582 22 | 3591.3 | 8.1024 | 550 |
| 560 | 0.696 97 | 3614.0 | 8.2067 | 0.638 70 | 3613.6 | 8.1662 | 0.589 41 | 3613.2 | 8.1288 | 560 |
| 570 | 0.705 43 | 3635.9 | 8.2329 | 0.646 47 | 3635.5 | 8.1923 | 0.596 59 | 3635.1 | 8.1550 | 570 |
| 580 | 0.713 90 | 3657.9 | 8.2588 | 0.654 24 | 3657.5 | 8.2183 | 0.603 76 | 3657.1 | 8.1809 | 580 |
| 590 | 0.722 37 | 3680.0 | 8.2845 | 0.662 01 | 3679.6 | 8.2439 | 0.610 93 | 3679.2 | 8.2067 | 590 |
| 600 | 0.730 83 | 3702.1 | 8.3099 | 0.669 77 | 3701.7 | 8.2694 | 0.618 10 | 3701.3 | 8.2321 | 600 |
| 610 | 0.739 28 | 3724.2 | 8.3352 | 0.677 53 | 3723.9 | 8.2947 | 0.625 27 | 3723.5 | 8.2574 | 610 |
| 620 | 0.747 74 | 3746.5 | 8.3602 | 0.685 28 | 3746.1 | 8.3197 | 0.632 43 | 3745.7 | 8.2825 | 620 |
| 630 | 0.756 19 | 3768.8 | 8.3850 | 0.693 04 | 3768.4 | 8.3446 | 0.639 60 | 3768.1 | 8.3073 | 630 |
| 640 | 0.764 64 | 3791.1 | 8.4097 | 0.700 79 | 3790.8 | 8.3692 | 0.646 76 | 3790.5 | 8.3320 | 640 |
| 650 | 0.773 09 | 3813.6 | 8.4341 | 0.708 54 | 3813.2 | 8.3937 | 0.653 91 | 3812.9 | 8.3564 | 650 |
| 660 | 0.781 54 | 3836.1 | 8.4583 | 0.716 28 | 3835.8 | 8.4179 | 0.661 07 | 3835.4 | 8.3807 | 660 |
| 670 | 0.789 98 | 3858.6 | 8.4824 | 0.724 03 | 3858.3 | 8.4420 | 0.668 22 | 3858.0 | 8.4048 | 670 |
| 680 | 0.798 42 | 3881.3 | 8.5063 | 0.731 77 | 3881.0 | 8.4659 | 0.675 37 | 3880.7 | 8.4287 | 680 |
| 690 | 0.806 86 | 3904.0 | 8.5300 | 0.739 51 | 3903.7 | 8.4896 | 0.682 52 | 3903.4 | 8.4524 | 690 |
| 700 | 0.815 30 | 3926.8 | 8.5535 | 0.747 25 | 3926.5 | 8.5131 | 0.689 67 | 3926.2 | 8.4759 | 700 |
| 710 | 0.823 74 | 3949.6 | 8.5768 | 0.754 99 | 3949.3 | 8.5364 | 0.696 82 | 3949.0 | 8.4993 | 710 |
| 720 | 0.832 18 | 3972.5 | 8.6000 | 0.762 73 | 3972.2 | 8.5596 | 0.703 96 | 3971.9 | 8.5225 | 720 |
| 730 | 0.840 61 | 3995.5 | 8.6230 | 0.770 46 | 3995.2 | 8.5827 | 0.711 11 | 3994.9 | 8.5455 | 730 |
| 740 | 0.849 04 | 4018.5 | 8.6459 | 0.778 20 | 4018.2 | 8.6055 | 0.718 25 | 4018.0 | 8.5684 | 740 |
| 750 | 0.857 48 | 4041.6 | 8.6686 | 0.785 93 | 4041.4 | 8.6282 | 0.725 39 | 4041.1 | 8.5911 | 750 |
| 760 | 0.865 91 | 4064.8 | 8.6911 | 0.793 66 | 4064.5 | 8.6508 | 0.732 53 | 4064.3 | 8.6136 | 760 |
| 770 | 0.874 33 | 4088.0 | 8.7135 | 0.801 39 | 4087.8 | 8.6732 | 0.739 67 | 4087.5 | 8.6360 | 770 |
| 780 | 0.882 76 | 4111.3 | 8.7358 | 0.809 12 | 4111.1 | 8.6954 | 0.746 80 | 4110.9 | 8.6583 | 780 |
| 790 | 0.891 19 | 4134.7 | 8.7578 | 0.816 84 | 4134.5 | 8.7175 | 0.753 94 | 4134.3 | 8.6804 | 790 |
| 800 | 0.899 62 | 4158.2 | 8.7798 | 0.824 58 | 4158.0 | 8.7395 | 0.761 08 | 4157.7 | 8.7024 | 800 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.70 MPa ($t_{sat}$ = 164.95 °C) | | | 0.75 MPa ($t_{sat}$ = 167.76 °C) | | | 0.80 MPa ($t_{sat}$ = 170.41 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 108 0 | 697.14 | 1.9921 | 0.001 111 4 | 709.38 | 2.0198 | 0.001 114 8 | 721.02 | 2.0460 | Sat. Liq. |
| Sat. Vap. | 0.272 76 | 2762.7 | 6.7070 | 0.255 50 | 2765.6 | 6.6835 | 0.240 33 | 2768.3 | 6.6615 | Sat. Vap. |
| 0 | 0.000 999 9 | 0.67 | -0.0001 | 0.000 999 8 | 0.72 | -0.0001 | 0.000 999 8 | 0.77 | -0.0001 | 0 |
| 5 | 0.000 999 7 | 21.72 | 0.0762 | 0.000 999 7 | 21.76 | 0.0762 | 0.000 999 7 | 21.81 | 0.0762 | 5 |
| 10 | 0.001 000 0 | 42.70 | 0.1510 | 0.001 000 0 | 42.75 | 0.1510 | 0.001 000 0 | 42.80 | 0.1510 | 10 |
| 15 | 0.001 000 6 | 63.65 | 0.2244 | 0.001 000 6 | 63.70 | 0.2244 | 0.001 000 6 | 63.75 | 0.2243 | 15 |
| 20 | 0.001 001 5 | 84.58 | 0.2964 | 0.001 001 5 | 84.62 | 0.2963 | 0.001 001 5 | 84.67 | 0.2963 | 20 |
| 25 | 0.001 002 7 | 105.48 | 0.3671 | 0.001 002 7 | 105.53 | 0.3671 | 0.001 002 6 | 105.58 | 0.3671 | 25 |
| 30 | 0.001 004 1 | 126.38 | 0.4366 | 0.001 004 1 | 126.43 | 0.4366 | 0.001 004 1 | 126.47 | 0.4366 | 30 |
| 35 | 0.001 005 7 | 147.27 | 0.5049 | 0.001 005 7 | 147.31 | 0.5049 | 0.001 005 7 | 147.36 | 0.5049 | 35 |
| 40 | 0.001 007 6 | 168.15 | 0.5722 | 0.001 007 5 | 168.20 | 0.5721 | 0.001 007 5 | 168.24 | 0.5721 | 40 |
| 45 | 0.001 009 6 | 189.04 | 0.6383 | 0.001 009 6 | 189.08 | 0.6383 | 0.001 009 6 | 189.13 | 0.6383 | 45 |
| 50 | 0.001 011 8 | 209.93 | 0.7035 | 0.001 011 8 | 209.97 | 0.7035 | 0.001 011 8 | 210.02 | 0.7034 | 50 |
| 55 | 0.001 014 2 | 230.82 | 0.7676 | 0.001 014 2 | 230.87 | 0.7676 | 0.001 014 2 | 230.91 | 0.7676 | 55 |
| 60 | 0.001 016 8 | 251.73 | 0.8309 | 0.001 016 8 | 251.77 | 0.8308 | 0.001 016 8 | 251.81 | 0.8308 | 60 |
| 65 | 0.001 019 5 | 272.64 | 0.8932 | 0.001 019 5 | 272.68 | 0.8931 | 0.001 019 5 | 272.72 | 0.8931 | 65 |
| 70 | 0.001 022 5 | 293.56 | 0.9546 | 0.001 022 4 | 293.61 | 0.9546 | 0.001 022 4 | 293.65 | 0.9545 | 70 |
| 75 | 0.001 025 5 | 314.51 | 1.0152 | 0.001 025 5 | 314.55 | 1.0152 | 0.001 025 5 | 314.59 | 1.0151 | 75 |
| 80 | 0.001 028 7 | 335.47 | 1.0750 | 0.001 028 7 | 335.51 | 1.0749 | 0.001 028 7 | 335.55 | 1.0749 | 80 |
| 85 | 0.001 032 1 | 356.45 | 1.1340 | 0.001 032 1 | 356.49 | 1.1339 | 0.001 032 1 | 356.53 | 1.1339 | 85 |
| 90 | 0.001 035 6 | 377.46 | 1.1922 | 0.001 035 6 | 377.49 | 1.1922 | 0.001 035 6 | 377.53 | 1.1921 | 90 |
| 95 | 0.001 039 3 | 398.49 | 1.2497 | 0.001 039 3 | 398.53 | 1.2497 | 0.001 039 3 | 398.56 | 1.2496 | 95 |
| 100 | 0.001 043 2 | 419.55 | 1.3065 | 0.001 043 1 | 419.59 | 1.3065 | 0.001 043 1 | 419.62 | 1.3065 | 100 |
| 105 | 0.001 047 1 | 440.64 | 1.3627 | 0.001 047 1 | 440.68 | 1.3627 | 0.001 047 1 | 440.72 | 1.3626 | 105 |
| 110 | 0.001 051 3 | 461.77 | 1.4182 | 0.001 051 3 | 461.80 | 1.4182 | 0.001 051 2 | 461.84 | 1.4181 | 110 |
| 115 | 0.001 055 6 | 482.93 | 1.4731 | 0.001 055 6 | 482.97 | 1.4730 | 0.001 055 5 | 483.00 | 1.4730 | 115 |
| 120 | 0.001 060 0 | 504.14 | 1.5274 | 0.001 060 0 | 504.17 | 1.5273 | 0.001 060 0 | 504.21 | 1.5273 | 120 |
| 125 | 0.001 064 7 | 525.38 | 1.5811 | 0.001 064 6 | 525.42 | 1.5810 | 0.001 064 6 | 525.45 | 1.5810 | 125 |
| 130 | 0.001 069 5 | 546.68 | 1.6342 | 0.001 069 4 | 546.71 | 1.6342 | 0.001 069 4 | 546.75 | 1.6341 | 130 |
| 135 | 0.001 074 4 | 568.02 | 1.6868 | 0.001 074 4 | 568.06 | 1.6868 | 0.001 074 4 | 568.09 | 1.6867 | 135 |
| 140 | 0.001 079 5 | 589.42 | 1.7389 | 0.001 079 5 | 589.45 | 1.7389 | 0.001 079 5 | 589.48 | 1.7388 | 140 |
| 145 | 0.001 084 9 | 610.87 | 1.7906 | 0.001 084 8 | 610.91 | 1.7905 | 0.001 084 8 | 610.94 | 1.7904 | 145 |
| 150 | 0.001 090 4 | 632.39 | 1.8417 | 0.001 090 3 | 632.42 | 1.8416 | 0.001 090 3 | 632.45 | 1.8416 | 150 |
| 155 | 0.001 096 0 | 653.97 | 1.8924 | 0.001 096 0 | 654.00 | 1.8923 | 0.001 096 0 | 654.03 | 1.8923 | 155 |
| 160 | 0.001 101 9 | 675.62 | 1.9427 | 0.001 101 9 | 675.65 | 1.9426 | 0.001 101 9 | 675.68 | 1.9426 | 160 |
| 165 | 0.272 80 | 2762.9 | 6.7073 | 0.001 108 0 | 697.38 | 1.9925 | 0.001 107 9 | 697.41 | 1.9924 | 165 |
| 170 | 0.276 85 | 2775.4 | 6.7356 | 0.257 23 | 2771.4 | 6.6965 | 0.001 114 3 | 719.21 | 2.0419 | 170 |
| 175 | 0.280 83 | 2787.5 | 6.7628 | 0.261 01 | 2783.8 | 6.7244 | 0.243 64 | 2780.0 | 6.6878 | 175 |
| 180 | 0.284 74 | 2799.4 | 6.7892 | 0.264 72 | 2795.9 | 6.7513 | 0.247 18 | 2792.4 | 6.7154 | 180 |
| 185 | 0.288 61 | 2811.1 | 6.8149 | 0.268 38 | 2807.8 | 6.7775 | 0.250 67 | 2804.6 | 6.7420 | 185 |
| 190 | 0.292 44 | 2822.6 | 6.8399 | 0.272 00 | 2819.6 | 6.8029 | 0.254 11 | 2816.5 | 6.7678 | 190 |
| 195 | 0.296 23 | 2834.0 | 6.8644 | 0.275 58 | 2831.1 | 6.8277 | 0.257 50 | 2828.2 | 6.7930 | 195 |
| 200 | 0.299 99 | 2845.3 | 6.8884 | 0.279 13 | 2842.5 | 6.8520 | 0.260 87 | 2839.8 | 6.8176 | 200 |
| 205 | 0.303 73 | 2856.5 | 6.9119 | 0.282 65 | 2853.9 | 6.8758 | 0.264 20 | 2851.2 | 6.8417 | 205 |
| 210 | 0.307 43 | 2867.6 | 6.9350 | 0.286 14 | 2865.1 | 6.8991 | 0.267 51 | 2862.6 | 6.8653 | 210 |
| 215 | 0.311 11 | 2878.6 | 6.9577 | 0.289 61 | 2876.2 | 6.9221 | 0.270 79 | 2873.8 | 6.8885 | 215 |
| 220 | 0.314 77 | 2889.5 | 6.9800 | 0.293 05 | 2887.3 | 6.9446 | 0.274 04 | 2885.0 | 6.9112 | 220 |
| 225 | 0.318 41 | 2900.4 | 7.0019 | 0.296 48 | 2898.3 | 6.9667 | 0.277 28 | 2896.1 | 6.9336 | 225 |
| 230 | 0.322 03 | 2911.3 | 7.0236 | 0.299 88 | 2909.2 | 6.9885 | 0.280 50 | 2907.1 | 6.9555 | 230 |
| 235 | 0.325 64 | 2922.0 | 7.0449 | 0.303 27 | 2920.0 | 7.0100 | 0.283 70 | 2918.0 | 6.9772 | 235 |
| 240 | 0.329 23 | 2932.8 | 7.0659 | 0.306 64 | 2930.8 | 7.0312 | 0.286 88 | 2928.9 | 6.9985 | 240 |
| 245 | 0.332 80 | 2943.5 | 7.0867 | 0.310 00 | 2941.6 | 7.0521 | 0.290 05 | 2939.7 | 7.0196 | 245 |
| 250 | 0.336 36 | 2954.1 | 7.1071 | 0.313 34 | 2952.3 | 7.0727 | 0.293 20 | 2950.5 | 7.0403 | 250 |
| 255 | 0.339 91 | 2964.8 | 7.1273 | 0.316 68 | 2963.0 | 7.0930 | 0.296 34 | 2961.3 | 7.0608 | 255 |
| 260 | 0.343 45 | 2975.4 | 7.1473 | 0.319 99 | 2973.7 | 7.1131 | 0.299 47 | 2972.0 | 7.0810 | 260 |
| 265 | 0.346 97 | 2985.9 | 7.1671 | 0.323 30 | 2984.3 | 7.1330 | 0.302 59 | 2982.7 | 7.1009 | 265 |
| 270 | 0.350 49 | 2996.5 | 7.1866 | 0.326 60 | 2994.9 | 7.1526 | 0.305 69 | 2993.4 | 7.1206 | 270 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 0.70 MPa ($t_{sat}$ = 164.95 °C) | | | 0.75 MPa ($t_{sat}$ = 167.76 °C) | | | 0.80 MPa ($t_{sat}$ = 170.41 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 0.354 00 | 3007.0 | 7.2059 | 0.329 89 | 3005.5 | 7.1720 | 0.308 79 | 3004.0 | 7.1401 | 275 |
| 280 | 0.357 49 | 3017.5 | 7.2250 | 0.333 17 | 3016.1 | 7.1912 | 0.311 88 | 3014.6 | 7.1594 | 280 |
| 285 | 0.360 98 | 3028.0 | 7.2439 | 0.336 44 | 3026.6 | 7.2102 | 0.314 96 | 3025.2 | 7.1785 | 285 |
| 290 | 0.364 47 | 3038.5 | 7.2626 | 0.339 70 | 3037.2 | 7.2290 | 0.318 03 | 3035.8 | 7.1974 | 290 |
| 295 | 0.367 94 | 3049.0 | 7.2812 | 0.342 96 | 3047.7 | 7.2476 | 0.321 09 | 3046.4 | 7.2160 | 295 |
| 300 | 0.371 41 | 3059.5 | 7.2995 | 0.346 20 | 3058.2 | 7.2660 | 0.324 15 | 3056.9 | 7.2345 | 300 |
| 310 | 0.378 32 | 3080.4 | 7.3357 | 0.352 68 | 3079.2 | 7.3023 | 0.330 25 | 3078.0 | 7.2710 | 310 |
| 320 | 0.385 22 | 3101.4 | 7.3713 | 0.359 14 | 3100.2 | 7.3380 | 0.336 32 | 3099.1 | 7.3068 | 320 |
| 330 | 0.392 09 | 3122.3 | 7.4063 | 0.365 57 | 3121.2 | 7.3731 | 0.342 37 | 3120.1 | 7.3420 | 330 |
| 340 | 0.398 94 | 3143.2 | 7.4407 | 0.371 98 | 3142.2 | 7.4076 | 0.348 40 | 3141.1 | 7.3765 | 340 |
| 350 | 0.405 78 | 3164.1 | 7.4745 | 0.378 38 | 3163.1 | 7.4415 | 0.354 41 | 3162.2 | 7.4106 | 350 |
| 360 | 0.412 60 | 3185.1 | 7.5079 | 0.384 76 | 3184.1 | 7.4749 | 0.360 41 | 3183.2 | 7.4441 | 360 |
| 370 | 0.419 41 | 3206.1 | 7.5408 | 0.391 13 | 3205.1 | 7.5079 | 0.366 39 | 3204.2 | 7.4771 | 370 |
| 380 | 0.426 20 | 3227.0 | 7.5732 | 0.397 49 | 3226.2 | 7.5403 | 0.372 36 | 3225.3 | 7.5096 | 380 |
| 390 | 0.432 98 | 3248.1 | 7.6051 | 0.403 83 | 3247.3 | 7.5723 | 0.378 32 | 3246.4 | 7.5416 | 390 |
| 400 | 0.439 76 | 3269.1 | 7.6366 | 0.410 17 | 3268.4 | 7.6039 | 0.384 27 | 3267.6 | 7.5733 | 400 |
| 410 | 0.446 52 | 3290.2 | 7.6678 | 0.416 49 | 3289.5 | 7.6351 | 0.390 21 | 3288.7 | 7.6045 | 410 |
| 420 | 0.453 27 | 3311.4 | 7.6985 | 0.422 80 | 3310.7 | 7.6659 | 0.396 14 | 3309.9 | 7.6353 | 420 |
| 430 | 0.460 02 | 3332.6 | 7.7288 | 0.429 11 | 3331.9 | 7.6962 | 0.402 06 | 3331.2 | 7.6657 | 430 |
| 440 | 0.466 75 | 3353.8 | 7.7588 | 0.435 41 | 3353.1 | 7.7263 | 0.407 98 | 3352.5 | 7.6958 | 440 |
| 450 | 0.473 48 | 3375.1 | 7.7884 | 0.441 70 | 3374.4 | 7.7559 | 0.413 88 | 3373.8 | 7.7255 | 450 |
| 460 | 0.480 21 | 3396.4 | 7.8177 | 0.447 98 | 3395.8 | 7.7853 | 0.419 78 | 3395.2 | 7.7548 | 460 |
| 470 | 0.486 92 | 3417.8 | 7.8467 | 0.454 26 | 3417.2 | 7.8143 | 0.425 68 | 3416.6 | 7.7839 | 470 |
| 480 | 0.493 64 | 3439.2 | 7.8753 | 0.460 53 | 3438.6 | 7.8429 | 0.431 56 | 3438.1 | 7.8126 | 480 |
| 490 | 0.500 34 | 3460.7 | 7.9037 | 0.466 80 | 3460.2 | 7.8713 | 0.437 44 | 3459.6 | 7.8410 | 490 |
| 500 | 0.507 04 | 3482.3 | 7.9317 | 0.473 06 | 3481.7 | 7.8994 | 0.443 32 | 3481.2 | 7.8690 | 500 |
| 510 | 0.513 74 | 3503.8 | 7.9595 | 0.479 31 | 3503.3 | 7.9271 | 0.449 19 | 3502.8 | 7.8969 | 510 |
| 520 | 0.520 43 | 3525.5 | 7.9870 | 0.485 56 | 3525.0 | 7.9546 | 0.455 06 | 3524.5 | 7.9244 | 520 |
| 530 | 0.527 11 | 3547.2 | 8.0142 | 0.491 81 | 3546.7 | 7.9819 | 0.460 92 | 3546.2 | 7.9516 | 530 |
| 540 | 0.533 80 | 3569.0 | 8.0411 | 0.498 05 | 3568.5 | 8.0088 | 0.466 78 | 3568.0 | 7.9786 | 540 |
| 550 | 0.540 48 | 3590.8 | 8.0678 | 0.504 29 | 3590.4 | 8.0355 | 0.472 63 | 3589.9 | 8.0053 | 550 |
| 560 | 0.547 15 | 3612.7 | 8.0942 | 0.510 53 | 3612.3 | 8.0620 | 0.478 49 | 3611.8 | 8.0318 | 560 |
| 570 | 0.553 82 | 3634.7 | 8.1204 | 0.516 76 | 3634.2 | 8.0882 | 0.484 33 | 3633.8 | 8.0580 | 570 |
| 580 | 0.560 49 | 3656.7 | 8.1464 | 0.522 99 | 3656.3 | 8.1142 | 0.490 18 | 3655.8 | 8.0840 | 580 |
| 590 | 0.567 16 | 3678.8 | 8.1721 | 0.529 22 | 3678.4 | 8.1399 | 0.496 02 | 3678.0 | 8.1098 | 590 |
| 600 | 0.573 82 | 3700.9 | 8.1976 | 0.535 44 | 3700.5 | 8.1654 | 0.501 86 | 3700.1 | 8.1353 | 600 |
| 610 | 0.580 48 | 3723.1 | 8.2229 | 0.541 66 | 3722.7 | 8.1907 | 0.507 69 | 3722.3 | 8.1606 | 610 |
| 620 | 0.587 14 | 3745.4 | 8.2480 | 0.547 88 | 3745.0 | 8.2158 | 0.513 53 | 3744.6 | 8.1857 | 620 |
| 630 | 0.593 79 | 3767.7 | 8.2728 | 0.554 09 | 3767.4 | 8.2407 | 0.519 36 | 3767.0 | 8.2106 | 630 |
| 640 | 0.600 44 | 3790.1 | 8.2975 | 0.560 31 | 3789.8 | 8.2654 | 0.525 19 | 3789.4 | 8.2353 | 640 |
| 650 | 0.607 09 | 3812.6 | 8.3220 | 0.566 52 | 3812.2 | 8.2898 | 0.531 01 | 3811.9 | 8.2598 | 650 |
| 660 | 0.613 74 | 3835.1 | 8.3462 | 0.572 73 | 3834.8 | 8.3141 | 0.536 84 | 3834.4 | 8.2841 | 660 |
| 670 | 0.620 39 | 3857.7 | 8.3703 | 0.578 93 | 3857.4 | 8.3382 | 0.542 66 | 3857.1 | 8.3082 | 670 |
| 680 | 0.627 03 | 3880.4 | 8.3942 | 0.585 14 | 3880.0 | 8.3621 | 0.548 48 | 3879.7 | 8.3321 | 680 |
| 690 | 0.633 68 | 3903.1 | 8.4179 | 0.591 34 | 3902.8 | 8.3859 | 0.554 30 | 3902.5 | 8.3558 | 690 |
| 700 | 0.640 32 | 3925.9 | 8.4415 | 0.597 54 | 3925.6 | 8.4094 | 0.560 11 | 3925.3 | 8.3794 | 700 |
| 710 | 0.646 96 | 3948.7 | 8.4649 | 0.603 74 | 3948.5 | 8.4328 | 0.565 93 | 3948.2 | 8.4028 | 710 |
| 720 | 0.653 59 | 3971.7 | 8.4881 | 0.609 94 | 3971.4 | 8.4560 | 0.571 74 | 3971.1 | 8.4260 | 720 |
| 730 | 0.660 23 | 3994.7 | 8.5111 | 0.616 14 | 3994.4 | 8.4790 | 0.577 55 | 3994.1 | 8.4490 | 730 |
| 740 | 0.666 86 | 4017.7 | 8.5340 | 0.622 33 | 4017.5 | 8.5019 | 0.583 36 | 4017.2 | 8.4719 | 740 |
| 750 | 0.673 50 | 4040.8 | 8.5567 | 0.628 52 | 4040.6 | 8.5246 | 0.589 17 | 4040.3 | 8.4947 | 750 |
| 760 | 0.680 13 | 4064.0 | 8.5792 | 0.634 72 | 4063.8 | 8.5472 | 0.594 98 | 4063.5 | 8.5172 | 760 |
| 770 | 0.686 76 | 4087.3 | 8.6017 | 0.640 91 | 4087.1 | 8.5696 | 0.600 79 | 4086.8 | 8.5397 | 770 |
| 780 | 0.693 39 | 4110.6 | 8.6239 | 0.647 10 | 4110.4 | 8.5919 | 0.606 59 | 4110.2 | 8.5619 | 780 |
| 790 | 0.700 02 | 4134.0 | 8.6460 | 0.653 29 | 4133.8 | 8.6140 | 0.612 40 | 4133.6 | 8.5840 | 790 |
| 800 | 0.706 65 | 4157.5 | 8.6680 | 0.659 48 | 4157.3 | 8.6360 | 0.618 21 | 4157.1 | 8.6060 | 800 |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 0.9 MPa ($t_{sat}$ = 175.36 °C) | | | 1.0 MPa ($t_{sat}$ = 179.89 °C) | | | 1.1 MPa ($t_{sat}$ = 184.07 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| Sat. Liq. | 0.001 121 2 | 742.72 | 2.0944 | 0.001 127 2 | 762.68 | 2.1384 | 0.001 133 0 | 781.20 | 2.1789 | Sat. Liq. |
| Sat. Vap. | 0.214 87 | 2773.0 | 6.6212 | 0.194 35 | 2777.1 | 6.5850 | 0.177 44 | 2780.7 | 6.5520 | Sat. Vap. |
| 0 | 0.000 999 7 | 0.87 | -0.0001 | 0.000 999 7 | 0.98 | -0.0001 | 0.000 999 6 | 1.08 | -0.0001 | 0 |
| 5 | 0.000 999 6 | 21.91 | 0.0762 | 0.000 999 6 | 22.01 | 0.0762 | 0.000 999 5 | 22.11 | 0.0762 | 5 |
| 10 | 0.000 999 9 | 42.90 | 0.1510 | 0.000 999 9 | 42.99 | 0.1510 | 0.000 999 8 | 43.09 | 0.1510 | 10 |
| 15 | 0.001 000 5 | 63.84 | 0.2243 | 0.001 000 5 | 63.94 | 0.2243 | 0.001 000 4 | 64.03 | 0.2243 | 15 |
| 20 | 0.001 001 4 | 84.76 | 0.2963 | 0.001 001 4 | 84.86 | 0.2963 | 0.001 001 3 | 84.95 | 0.2963 | 20 |
| 25 | 0.001 002 6 | 105.67 | 0.3670 | 0.001 002 6 | 105.76 | 0.3670 | 0.001 002 5 | 105.85 | 0.3670 | 25 |
| 30 | 0.001 004 0 | 126.56 | 0.4365 | 0.001 004 0 | 126.65 | 0.4365 | 0.001 003 9 | 126.74 | 0.4365 | 30 |
| 35 | 0.001 005 6 | 147.45 | 0.5049 | 0.001 005 6 | 147.54 | 0.5048 | 0.001 005 6 | 147.63 | 0.5048 | 35 |
| 40 | 0.001 007 5 | 168.33 | 0.5721 | 0.001 007 4 | 168.42 | 0.5720 | 0.001 007 4 | 168.51 | 0.5720 | 40 |
| 45 | 0.001 009 5 | 189.22 | 0.6382 | 0.001 009 5 | 189.30 | 0.6382 | 0.001 009 4 | 189.39 | 0.6382 | 45 |
| 50 | 0.001 011 7 | 210.10 | 0.7034 | 0.001 011 7 | 210.19 | 0.7033 | 0.001 011 7 | 210.27 | 0.7033 | 50 |
| 55 | 0.001 014 1 | 230.99 | 0.7675 | 0.001 014 1 | 231.08 | 0.7675 | 0.001 014 1 | 231.16 | 0.7674 | 55 |
| 60 | 0.001 016 7 | 251.89 | 0.8307 | 0.001 016 7 | 251.98 | 0.8307 | 0.001 016 6 | 252.06 | 0.8306 | 60 |
| 65 | 0.001 019 5 | 272.80 | 0.8930 | 0.001 019 4 | 272.89 | 0.8930 | 0.001 019 4 | 272.97 | 0.8929 | 65 |
| 70 | 0.001 022 4 | 293.73 | 0.9545 | 0.001 022 3 | 293.81 | 0.9544 | 0.001 022 3 | 293.89 | 0.9544 | 70 |
| 75 | 0.001 025 4 | 314.67 | 1.0151 | 0.001 025 4 | 314.75 | 1.0150 | 0.001 025 3 | 314.83 | 1.0149 | 75 |
| 80 | 0.001 028 6 | 335.63 | 1.0748 | 0.001 028 6 | 335.71 | 1.0748 | 0.001 028 5 | 335.79 | 1.0747 | 80 |
| 85 | 0.001 032 0 | 356.61 | 1.1338 | 0.001 032 0 | 356.69 | 1.1338 | 0.001 031 9 | 356.76 | 1.1337 | 85 |
| 90 | 0.001 035 5 | 377.61 | 1.1921 | 0.001 035 5 | 377.69 | 1.1920 | 0.001 035 4 | 377.77 | 1.1919 | 90 |
| 95 | 0.001 039 2 | 398.64 | 1.2496 | 0.001 039 2 | 398.72 | 1.2495 | 0.001 039 1 | 398.79 | 1.2494 | 95 |
| 100 | 0.001 043 0 | 419.70 | 1.3064 | 0.001 043 0 | 419.77 | 1.3063 | 0.001 042 9 | 419.85 | 1.3062 | 100 |
| 105 | 0.001 047 0 | 440.79 | 1.3625 | 0.001 047 0 | 440.86 | 1.3625 | 0.001 046 9 | 440.94 | 1.3624 | 105 |
| 110 | 0.001 051 2 | 461.91 | 1.4180 | 0.001 051 1 | 461.99 | 1.4179 | 0.001 051 1 | 462.06 | 1.4179 | 110 |
| 115 | 0.001 055 5 | 483.08 | 1.4729 | 0.001 055 4 | 483.15 | 1.4728 | 0.001 055 4 | 483.22 | 1.4727 | 115 |
| 120 | 0.001 059 9 | 504.28 | 1.5272 | 0.001 059 9 | 504.35 | 1.5271 | 0.001 059 8 | 504.42 | 1.5270 | 120 |
| 125 | 0.001 064 6 | 525.52 | 1.5809 | 0.001 064 5 | 525.59 | 1.5808 | 0.001 064 4 | 525.66 | 1.5807 | 125 |
| 130 | 0.001 069 3 | 546.81 | 1.6340 | 0.001 069 3 | 546.88 | 1.6339 | 0.001 069 2 | 546.95 | 1.6338 | 130 |
| 135 | 0.001 074 3 | 568.15 | 1.6866 | 0.001 074 2 | 568.22 | 1.6865 | 0.001 074 2 | 568.29 | 1.6864 | 135 |
| 140 | 0.001 079 4 | 589.55 | 1.7387 | 0.001 079 4 | 589.61 | 1.7386 | 0.001 079 3 | 589.68 | 1.7385 | 140 |
| 145 | 0.001 084 7 | 611.00 | 1.7903 | 0.001 084 7 | 611.06 | 1.7902 | 0.001 084 6 | 611.13 | 1.7901 | 145 |
| 150 | 0.001 090 2 | 632.51 | 1.8415 | 0.001 090 2 | 632.57 | 1.8414 | 0.001 090 1 | 632.64 | 1.8413 | 150 |
| 155 | 0.001 095 9 | 654.09 | 1.8922 | 0.001 095 8 | 654.15 | 1.8921 | 0.001 095 8 | 654.21 | 1.8919 | 155 |
| 160 | 0.001 101 8 | 675.74 | 1.9424 | 0.001 101 7 | 675.80 | 1.9423 | 0.001 101 6 | 675.86 | 1.9422 | 160 |
| 165 | 0.001 107 9 | 697.46 | 1.9923 | 0.001 107 8 | 697.52 | 1.9922 | 0.001 107 7 | 697.58 | 1.9921 | 165 |
| 170 | 0.001 114 2 | 719.27 | 2.0418 | 0.001 114 1 | 719.32 | 2.0417 | 0.001 114 0 | 719.37 | 2.0415 | 170 |
| 175 | 0.001 120 7 | 741.15 | 2.0909 | 0.001 120 6 | 741.21 | 2.0908 | 0.001 120 5 | 741.26 | 2.0906 | 175 |
| 180 | 0.217 91 | 2785.2 | 6.6481 | 0.194 42 | 2777.4 | 6.5857 | 0.001 127 3 | 763.24 | 2.1394 | 180 |
| 185 | 0.221 10 | 2797.8 | 6.6758 | 0.197 40 | 2790.7 | 6.6148 | 0.177 95 | 2783.2 | 6.5576 | 185 |
| 190 | 0.224 25 | 2810.1 | 6.7026 | 0.200 32 | 2803.5 | 6.6426 | 0.180 70 | 2796.7 | 6.5867 | 190 |
| 195 | 0.227 34 | 2822.2 | 6.7286 | 0.203 18 | 2816.0 | 6.6695 | 0.183 38 | 2809.6 | 6.6146 | 195 |
| 200 | 0.230 40 | 2834.1 | 6.7538 | 0.206 00 | 2828.3 | 6.6955 | 0.186 01 | 2822.3 | 6.6414 | 200 |
| 205 | 0.233 43 | 2845.8 | 6.7785 | 0.208 79 | 2840.3 | 6.7208 | 0.188 60 | 2834.6 | 6.6675 | 205 |
| 210 | 0.236 43 | 2857.4 | 6.8027 | 0.211 54 | 2852.2 | 6.7455 | 0.191 16 | 2846.8 | 6.6928 | 210 |
| 215 | 0.239 40 | 2868.9 | 6.8263 | 0.214 27 | 2863.9 | 6.7697 | 0.193 68 | 2858.8 | 6.7175 | 215 |
| 220 | 0.242 34 | 2880.3 | 6.8495 | 0.216 97 | 2875.6 | 6.7934 | 0.196 18 | 2870.7 | 6.7417 | 220 |
| 225 | 0.245 27 | 2891.6 | 6.8723 | 0.219 64 | 2887.0 | 6.8166 | 0.198 66 | 2882.4 | 6.7654 | 225 |
| 230 | 0.248 17 | 2902.8 | 6.8947 | 0.222 30 | 2898.4 | 6.8393 | 0.201 11 | 2894.0 | 6.7885 | 230 |
| 235 | 0.251 06 | 2913.9 | 6.9167 | 0.224 93 | 2909.8 | 6.8617 | 0.203 55 | 2905.5 | 6.8113 | 235 |
| 240 | 0.253 93 | 2925.0 | 6.9383 | 0.227 55 | 2921.0 | 6.8837 | 0.205 96 | 2916.9 | 6.8336 | 240 |
| 245 | 0.256 78 | 2936.0 | 6.9596 | 0.230 15 | 2932.1 | 6.9053 | 0.208 36 | 2928.2 | 6.8556 | 245 |
| 250 | 0.259 62 | 2946.9 | 6.9806 | 0.232 74 | 2943.2 | 6.9266 | 0.210 74 | 2939.5 | 6.8772 | 250 |
| 255 | 0.262 44 | 2957.8 | 7.0014 | 0.235 31 | 2954.3 | 6.9476 | 0.213 11 | 2950.7 | 6.8984 | 255 |
| 260 | 0.265 25 | 2968.6 | 7.0218 | 0.237 87 | 2965.2 | 6.9683 | 0.215 46 | 2961.8 | 6.9193 | 260 |
| 265 | 0.268 05 | 2979.5 | 7.0420 | 0.240 42 | 2976.2 | 6.9887 | 0.217 80 | 2972.8 | 6.9400 | 265 |
| 270 | 0.270 84 | 2990.2 | 7.0619 | 0.242 96 | 2987.0 | 7.0088 | 0.220 13 | 2983.8 | 6.9603 | 270 |

**UNITS**: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 0.9 MPa ($t_{sat}$ = 175.36 °C) | | | 1.0 MPa ($t_{sat}$ = 179.89 °C) | | | 1.1 MPa ($t_{sat}$ = 184.07 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| 275 | 0.273 62 | 3001.0 | 7.0816 | 0.245 48 | 2997.9 | 7.0287 | 0.222 45 | 2994.8 | 6.9804 | 275 |
| 280 | 0.276 39 | 3011.7 | 7.1010 | 0.248 00 | 3008.7 | 7.0484 | 0.224 76 | 3005.7 | 7.0003 | 280 |
| 285 | 0.279 15 | 3022.4 | 7.1203 | 0.250 51 | 3019.5 | 7.0678 | 0.227 06 | 3016.6 | 7.0198 | 285 |
| 290 | 0.281 91 | 3033.0 | 7.1393 | 0.253 00 | 3030.3 | 7.0870 | 0.229 35 | 3027.4 | 7.0392 | 290 |
| 295 | 0.284 65 | 3043.7 | 7.1581 | 0.255 50 | 3041.0 | 7.1059 | 0.231 64 | 3038.3 | 7.0583 | 295 |
| 300 | 0.287 39 | 3054.3 | 7.1768 | 0.257 98 | 3051.7 | 7.1247 | 0.233 91 | 3049.1 | 7.0773 | 300 |
| 310 | 0.292 85 | 3075.5 | 7.2135 | 0.262 93 | 3073.1 | 7.1617 | 0.238 44 | 3070.6 | 7.1145 | 310 |
| 320 | 0.298 28 | 3096.7 | 7.2495 | 0.267 85 | 3094.4 | 7.1979 | 0.242 95 | 3092.0 | 7.1510 | 320 |
| 330 | 0.303 69 | 3117.9 | 7.2849 | 0.272 75 | 3115.7 | 7.2335 | 0.247 43 | 3113.4 | 7.1868 | 330 |
| 340 | 0.309 08 | 3139.0 | 7.3196 | 0.277 63 | 3136.9 | 7.2685 | 0.251 89 | 3134.8 | 7.2219 | 340 |
| 350 | 0.314 46 | 3160.2 | 7.3538 | 0.282 49 | 3158.2 | 7.3028 | 0.256 34 | 3156.2 | 7.2564 | 350 |
| 360 | 0.319 82 | 3181.3 | 7.3875 | 0.287 34 | 3179.4 | 7.3366 | 0.260 77 | 3177.5 | 7.2904 | 360 |
| 370 | 0.325 16 | 3202.4 | 7.4206 | 0.292 17 | 3200.6 | 7.3699 | 0.265 18 | 3198.8 | 7.3238 | 370 |
| 380 | 0.330 49 | 3223.6 | 7.4532 | 0.296 99 | 3221.9 | 7.4026 | 0.269 58 | 3220.1 | 7.3567 | 380 |
| 390 | 0.335 81 | 3244.8 | 7.4854 | 0.301 80 | 3243.1 | 7.4349 | 0.273 97 | 3241.4 | 7.3891 | 390 |
| 400 | 0.341 12 | 3266.0 | 7.5172 | 0.306 59 | 3264.4 | 7.4668 | 0.278 35 | 3262.8 | 7.4210 | 400 |
| 410 | 0.346 42 | 3287.2 | 7.5485 | 0.311 38 | 3285.7 | 7.4982 | 0.282 71 | 3284.2 | 7.4525 | 410 |
| 420 | 0.351 71 | 3308.5 | 7.5794 | 0.316 16 | 3307.0 | 7.5292 | 0.287 07 | 3305.5 | 7.4836 | 420 |
| 430 | 0.356 99 | 3329.8 | 7.6099 | 0.320 93 | 3328.4 | 7.5598 | 0.291 42 | 3327.0 | 7.5143 | 430 |
| 440 | 0.362 26 | 3351.1 | 7.6400 | 0.325 69 | 3349.8 | 7.5900 | 0.295 76 | 3348.4 | 7.5446 | 440 |
| 450 | 0.367 53 | 3372.5 | 7.6698 | 0.330 44 | 3371.2 | 7.6198 | 0.300 10 | 3369.9 | 7.5745 | 450 |
| 460 | 0.372 78 | 3393.9 | 7.6992 | 0.335 19 | 3392.7 | 7.6493 | 0.304 42 | 3391.4 | 7.6040 | 460 |
| 470 | 0.378 04 | 3415.4 | 7.7283 | 0.339 93 | 3414.2 | 7.6785 | 0.308 74 | 3413.0 | 7.6332 | 470 |
| 480 | 0.383 28 | 3436.9 | 7.7571 | 0.344 66 | 3435.7 | 7.7073 | 0.313 06 | 3434.6 | 7.6621 | 480 |
| 490 | 0.388 52 | 3458.5 | 7.7855 | 0.349 39 | 3457.3 | 7.7358 | 0.317 37 | 3456.2 | 7.6907 | 490 |
| 500 | 0.393 76 | 3480.1 | 7.8136 | 0.354 11 | 3479.0 | 7.7640 | 0.321 67 | 3477.9 | 7.7189 | 500 |
| 510 | 0.398 99 | 3501.8 | 7.8415 | 0.358 83 | 3500.7 | 7.7919 | 0.325 97 | 3499.7 | 7.7469 | 510 |
| 520 | 0.404 22 | 3523.5 | 7.8691 | 0.363 54 | 3522.5 | 7.8195 | 0.330 26 | 3521.5 | 7.7745 | 520 |
| 530 | 0.409 44 | 3545.3 | 7.8963 | 0.368 25 | 3544.3 | 7.8468 | 0.334 55 | 3543.3 | 7.8019 | 530 |
| 540 | 0.414 66 | 3567.1 | 7.9234 | 0.372 96 | 3566.2 | 7.8739 | 0.338 84 | 3565.2 | 7.8290 | 540 |
| 550 | 0.419 87 | 3589.0 | 7.9501 | 0.377 66 | 3588.1 | 7.9007 | 0.343 12 | 3587.2 | 7.8558 | 550 |
| 560 | 0.425 08 | 3610.9 | 7.9766 | 0.382 35 | 3610.1 | 7.9272 | 0.347 40 | 3609.2 | 7.8824 | 560 |
| 570 | 0.430 29 | 3632.9 | 8.0029 | 0.387 05 | 3632.1 | 7.9535 | 0.351 67 | 3631.2 | 7.9087 | 570 |
| 580 | 0.435 49 | 3655.0 | 8.0289 | 0.391 74 | 3654.2 | 7.9795 | 0.355 94 | 3653.4 | 7.9348 | 580 |
| 590 | 0.440 69 | 3677.1 | 8.0547 | 0.396 43 | 3676.3 | 8.0054 | 0.360 21 | 3675.5 | 7.9607 | 590 |
| 600 | 0.445 89 | 3699.3 | 8.0803 | 0.401 11 | 3698.6 | 8.0309 | 0.364 48 | 3697.8 | 7.9863 | 600 |
| 610 | 0.451 08 | 3721.6 | 8.1056 | 0.405 79 | 3720.8 | 8.0563 | 0.368 74 | 3720.1 | 8.0117 | 610 |
| 620 | 0.456 27 | 3743.9 | 8.1307 | 0.410 47 | 3743.2 | 8.0815 | 0.373 00 | 3742.4 | 8.0368 | 620 |
| 630 | 0.461 46 | 3766.3 | 8.1556 | 0.415 15 | 3765.6 | 8.1064 | 0.377 26 | 3764.9 | 8.0618 | 630 |
| 640 | 0.466 65 | 3788.7 | 8.1803 | 0.419 82 | 3788.0 | 8.1311 | 0.381 51 | 3787.3 | 8.0866 | 640 |
| 650 | 0.471 84 | 3811.2 | 8.2049 | 0.424 50 | 3810.5 | 8.1557 | 0.385 76 | 3809.9 | 8.1111 | 650 |
| 660 | 0.477 02 | 3833.8 | 8.2292 | 0.429 17 | 3833.1 | 8.1800 | 0.390 01 | 3832.5 | 8.1355 | 660 |
| 670 | 0.482 20 | 3856.4 | 8.2533 | 0.433 84 | 3855.8 | 8.2041 | 0.394 26 | 3855.1 | 8.1596 | 670 |
| 680 | 0.487 38 | 3879.1 | 8.2772 | 0.438 50 | 3878.5 | 8.2281 | 0.398 51 | 3877.9 | 8.1836 | 680 |
| 690 | 0.492 56 | 3901.9 | 8.3010 | 0.443 17 | 3901.3 | 8.2519 | 0.402 76 | 3900.7 | 8.2074 | 690 |
| 700 | 0.497 73 | 3924.7 | 8.3246 | 0.447 83 | 3924.1 | 8.2755 | 0.407 00 | 3923.5 | 8.2310 | 700 |
| 710 | 0.502 91 | 3947.6 | 8.3480 | 0.452 49 | 3947.0 | 8.2989 | 0.411 24 | 3946.5 | 8.2544 | 710 |
| 720 | 0.508 08 | 3970.6 | 8.3712 | 0.457 15 | 3970.0 | 8.3221 | 0.415 48 | 3969.4 | 8.2777 | 720 |
| 730 | 0.513 25 | 3993.6 | 8.3943 | 0.461 81 | 3993.0 | 8.3452 | 0.419 72 | 3992.5 | 8.3008 | 730 |
| 740 | 0.518 42 | 4016.7 | 8.4172 | 0.466 47 | 4016.1 | 8.3681 | 0.423 96 | 4015.6 | 8.3237 | 740 |
| 750 | 0.523 59 | 4039.8 | 8.4399 | 0.471 12 | 4039.3 | 8.3909 | 0.428 19 | 4038.8 | 8.3465 | 750 |
| 760 | 0.528 76 | 4063.0 | 8.4625 | 0.475 77 | 4062.5 | 8.4135 | 0.432 43 | 4062.0 | 8.3691 | 760 |
| 770 | 0.533 92 | 4086.3 | 8.4849 | 0.480 43 | 4085.8 | 8.4359 | 0.436 66 | 4085.4 | 8.3916 | 770 |
| 780 | 0.539 09 | 4109.7 | 8.5072 | 0.485 08 | 4109.2 | 8.4582 | 0.440 89 | 4108.7 | 8.4139 | 780 |
| 790 | 0.544 25 | 4133.1 | 8.5293 | 0.489 73 | 4132.6 | 8.4804 | 0.445 12 | 4132.2 | 8.4360 | 790 |
| 800 | 0.549 42 | 4156.6 | 8.5513 | 0.494 39 | 4156.2 | 8.5024 | 0.449 36 | 4155.7 | 8.4580 | 800 |

UNITS: $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 1.2 MPa ($t_{sat}$ = 187.96 °C) | | | 1.3 MPa ($t_{sat}$ = 191.61 °C) | | | 1.4 MPa ($t_{sat}$ = 195.05 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 138 5 | 798.50 | 2.2163 | 0.001 143 8 | 814.76 | 2.2512 | 0.001 148 9 | 830.13 | 2.2839 | Sat. Liq. |
| Sat. Vap. | 0.163 25 | 2783.8 | 6.5217 | 0.151 17 | 2786.5 | 6.4936 | 0.140 77 | 2788.9 | 6.4675 | Sat. Vap. |
| **0** | 0.000 999 6 | 1.18 | -0.0001 | 0.000 999 5 | 1.28 | -0.0001 | 0.000 999 5 | 1.38 | -0.0001 | **0** |
| **5** | 0.000 999 5 | 22.21 | 0.0762 | 0.000 999 4 | 22.31 | 0.0762 | 0.000 999 4 | 22.41 | 0.0762 | **5** |
| **10** | 0.000 999 8 | 43.19 | 0.1510 | 0.000 999 7 | 43.29 | 0.1510 | 0.000 999 7 | 43.38 | 0.1510 | **10** |
| **15** | 0.001 000 4 | 64.13 | 0.2243 | 0.001 000 3 | 64.23 | 0.2243 | 0.001 000 3 | 64.32 | 0.2243 | **15** |
| **20** | 0.001 001 3 | 85.05 | 0.2963 | 0.001 001 2 | 85.14 | 0.2962 | 0.001 001 2 | 85.23 | 0.2962 | **20** |
| **25** | 0.001 002 5 | 105.95 | 0.3669 | 0.001 002 4 | 106.04 | 0.3669 | 0.001 002 4 | 106.13 | 0.3669 | **25** |
| **30** | 0.001 003 9 | 126.84 | 0.4364 | 0.001 003 8 | 126.93 | 0.4364 | 0.001 003 8 | 127.02 | 0.4364 | **30** |
| **35** | 0.001 005 5 | 147.72 | 0.5048 | 0.001 005 5 | 147.81 | 0.5047 | 0.001 005 4 | 147.90 | 0.5047 | **35** |
| **40** | 0.001 007 3 | 168.60 | 0.5720 | 0.001 007 3 | 168.69 | 0.5719 | 0.001 007 3 | 168.77 | 0.5719 | **40** |
| **45** | 0.001 009 4 | 189.48 | 0.6381 | 0.001 009 3 | 189.56 | 0.6381 | 0.001 009 3 | 189.65 | 0.6380 | **45** |
| **50** | 0.001 011 6 | 210.36 | 0.7032 | 0.001 011 6 | 210.45 | 0.7032 | 0.001 011 5 | 210.53 | 0.7032 | **50** |
| **55** | 0.001 014 0 | 231.25 | 0.7674 | 0.001 014 0 | 231.33 | 0.7673 | 0.001 013 9 | 231.42 | 0.7673 | **55** |
| **60** | 0.001 016 6 | 252.15 | 0.8306 | 0.001 016 5 | 252.23 | 0.8305 | 0.001 016 5 | 252.31 | 0.8305 | **60** |
| **65** | 0.001 019 3 | 273.05 | 0.8929 | 0.001 019 3 | 273.14 | 0.8928 | 0.001 019 2 | 273.22 | 0.8928 | **65** |
| **70** | 0.001 022 2 | 293.97 | 0.9543 | 0.001 022 2 | 294.06 | 0.9542 | 0.001 022 1 | 294.14 | 0.9542 | **70** |
| **75** | 0.001 025 3 | 314.91 | 1.0149 | 0.001 025 2 | 314.99 | 1.0148 | 0.001 025 2 | 315.07 | 1.0147 | **75** |
| **80** | 0.001 028 5 | 335.87 | 1.0746 | 0.001 028 4 | 335.95 | 1.0746 | 0.001 028 4 | 336.03 | 1.0745 | **80** |
| **85** | 0.001 031 9 | 356.84 | 1.1336 | 0.001 031 8 | 356.92 | 1.1335 | 0.001 031 8 | 357.00 | 1.1335 | **85** |
| **90** | 0.001 035 4 | 377.84 | 1.1918 | 0.001 035 3 | 377.92 | 1.1918 | 0.001 035 3 | 378.00 | 1.1917 | **90** |
| **95** | 0.001 039 1 | 398.87 | 1.2493 | 0.001 039 0 | 398.95 | 1.2493 | 0.001 039 0 | 399.02 | 1.2492 | **95** |
| **100** | 0.001 042 9 | 419.92 | 1.3062 | 0.001 042 8 | 420.00 | 1.3061 | 0.001 042 8 | 420.07 | 1.3060 | **100** |
| **105** | 0.001 046 9 | 441.01 | 1.3623 | 0.001 046 8 | 441.09 | 1.3622 | 0.001 046 8 | 441.16 | 1.3621 | **105** |
| **110** | 0.001 051 0 | 462.13 | 1.4178 | 0.001 051 0 | 462.21 | 1.4177 | 0.001 050 9 | 462.28 | 1.4176 | **110** |
| **115** | 0.001 055 3 | 483.29 | 1.4726 | 0.001 055 3 | 483.36 | 1.4726 | 0.001 055 2 | 483.43 | 1.4725 | **115** |
| **120** | 0.001 059 8 | 504.49 | 1.5269 | 0.001 059 7 | 504.56 | 1.5268 | 0.001 059 7 | 504.63 | 1.5267 | **120** |
| **125** | 0.001 064 4 | 525.73 | 1.5806 | 0.001 064 3 | 525.80 | 1.5805 | 0.001 064 3 | 525.87 | 1.5804 | **125** |
| **130** | 0.001 069 2 | 547.02 | 1.6337 | 0.001 069 1 | 547.08 | 1.6336 | 0.001 069 0 | 547.15 | 1.6335 | **130** |
| **135** | 0.001 074 1 | 568.35 | 1.6863 | 0.001 074 0 | 568.42 | 1.6862 | 0.001 074 0 | 568.49 | 1.6861 | **135** |
| **140** | 0.001 079 2 | 589.74 | 1.7384 | 0.001 079 2 | 589.81 | 1.7383 | 0.001 079 1 | 589.87 | 1.7382 | **140** |
| **145** | 0.001 084 5 | 611.19 | 1.7900 | 0.001 084 5 | 611.25 | 1.7899 | 0.001 084 4 | 611.32 | 1.7898 | **145** |
| **150** | 0.001 090 0 | 632.70 | 1.8411 | 0.001 089 9 | 632.76 | 1.8410 | 0.001 089 9 | 632.82 | 1.8409 | **150** |
| **155** | 0.001 095 7 | 654.27 | 1.8918 | 0.001 095 6 | 654.33 | 1.8917 | 0.001 095 6 | 654.39 | 1.8916 | **155** |
| **160** | 0.001 101 6 | 675.91 | 1.9421 | 0.001 101 5 | 675.97 | 1.9420 | 0.001 101 4 | 676.03 | 1.9418 | **160** |
| **165** | 0.001 107 6 | 697.63 | 1.9919 | 0.001 107 6 | 697.69 | 1.9918 | 0.001 107 5 | 697.74 | 1.9917 | **165** |
| **170** | 0.001 113 9 | 719.43 | 2.0414 | 0.001 113 9 | 719.48 | 2.0413 | 0.001 113 8 | 719.54 | 2.0411 | **170** |
| **175** | 0.001 120 5 | 741.31 | 2.0905 | 0.001 120 4 | 741.36 | 2.0904 | 0.001 120 3 | 741.42 | 2.0902 | **175** |
| **180** | 0.001 127 2 | 763.29 | 2.1393 | 0.001 127 1 | 763.34 | 2.1391 | 0.001 127 1 | 763.39 | 2.1390 | **180** |
| **185** | 0.001 134 2 | 785.36 | 2.1877 | 0.001 134 1 | 785.41 | 2.1876 | 0.001 134 0 | 785.46 | 2.1874 | **185** |
| **190** | 0.164 30 | 2789.4 | 6.5340 | 0.001 141 4 | 807.59 | 2.2357 | 0.001 141 3 | 807.63 | 2.2356 | **190** |
| **195** | 0.166 84 | 2803.0 | 6.5630 | 0.152 81 | 2796.0 | 6.5141 | 0.001 148 8 | 829.92 | 2.2834 | **195** |
| **200** | 0.169 32 | 2816.1 | 6.5908 | 0.155 17 | 2809.6 | 6.5430 | 0.143 01 | 2803.0 | 6.4975 | **200** |
| **205** | 0.171 76 | 2828.8 | 6.6177 | 0.157 48 | 2822.8 | 6.5707 | 0.145 21 | 2816.6 | 6.5262 | **205** |
| **210** | 0.174 15 | 2841.3 | 6.6437 | 0.159 74 | 2835.7 | 6.5975 | 0.147 37 | 2829.9 | 6.5537 | **210** |
| **215** | 0.176 51 | 2853.6 | 6.6690 | 0.161 97 | 2848.3 | 6.6234 | 0.149 48 | 2842.8 | 6.5803 | **215** |
| **220** | 0.178 85 | 2865.7 | 6.6937 | 0.164 17 | 2860.7 | 6.6487 | 0.151 57 | 2855.5 | 6.6062 | **220** |
| **225** | 0.181 16 | 2877.7 | 6.7178 | 0.166 34 | 2872.9 | 6.6733 | 0.153 62 | 2867.9 | 6.6313 | **225** |
| **230** | 0.183 45 | 2889.5 | 6.7414 | 0.168 48 | 2884.9 | 6.6973 | 0.155 65 | 2880.2 | 6.6559 | **230** |
| **235** | 0.185 71 | 2901.2 | 6.7645 | 0.170 61 | 2896.8 | 6.7209 | 0.157 65 | 2892.4 | 6.6798 | **235** |
| **240** | 0.187 96 | 2912.8 | 6.7872 | 0.172 71 | 2908.6 | 6.7440 | 0.159 64 | 2904.3 | 6.7033 | **240** |
| **245** | 0.190 18 | 2924.3 | 6.8095 | 0.174 80 | 2920.3 | 6.7666 | 0.161 60 | 2916.2 | 6.7263 | **245** |
| **250** | 0.192 40 | 2935.7 | 6.8314 | 0.176 87 | 2931.8 | 6.7888 | 0.163 55 | 2927.9 | 6.7488 | **250** |
| **255** | 0.194 59 | 2947.0 | 6.8530 | 0.178 92 | 2943.3 | 6.8106 | 0.165 48 | 2939.6 | 6.7710 | **255** |
| **260** | 0.196 78 | 2958.3 | 6.8742 | 0.180 96 | 2954.7 | 6.8321 | 0.167 40 | 2951.1 | 6.7927 | **260** |
| **265** | 0.198 95 | 2969.4 | 6.8950 | 0.182 99 | 2966.0 | 6.8532 | 0.169 30 | 2962.6 | 6.8141 | **265** |
| **270** | 0.201 11 | 2980.6 | 6.9156 | 0.185 00 | 2977.3 | 6.8740 | 0.171 19 | 2973.9 | 6.8352 | **270** |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 1.2 MPa ($t_{sat}$ = 187.96 °C) | | | 1.3 MPa ($t_{sat}$ = 191.61 °C) | | | 1.4 MPa ($t_{sat}$ = 195.05 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 0.203 25 | 2991.6 | 6.9359 | 0.187 00 | 2988.5 | 6.8946 | 0.173 07 | 2985.3 | 6.8559 | 275 |
| 280 | 0.205 39 | 3002.7 | 6.9559 | 0.189 00 | 2999.6 | 6.9148 | 0.174 94 | 2996.5 | 6.8763 | 280 |
| 285 | 0.207 52 | 3013.7 | 6.9757 | 0.190 98 | 3010.7 | 6.9347 | 0.176 80 | 3007.7 | 6.8965 | 285 |
| 290 | 0.209 64 | 3024.6 | 6.9952 | 0.192 95 | 3021.7 | 6.9544 | 0.178 65 | 3018.8 | 6.9163 | 290 |
| 295 | 0.211 75 | 3035.5 | 7.0145 | 0.194 92 | 3032.7 | 6.9739 | 0.180 49 | 3029.9 | 6.9360 | 295 |
| 300 | 0.213 85 | 3046.4 | 7.0336 | 0.196 87 | 3043.7 | 6.9931 | 0.182 32 | 3041.0 | 6.9553 | 300 |
| 310 | 0.218 03 | 3068.1 | 7.0711 | 0.200 76 | 3065.6 | 7.0309 | 0.185 96 | 3063.0 | 6.9934 | 310 |
| 320 | 0.222 19 | 3089.7 | 7.1078 | 0.204 63 | 3087.3 | 7.0679 | 0.189 57 | 3084.9 | 7.0306 | 320 |
| 330 | 0.226 33 | 3111.2 | 7.1438 | 0.208 47 | 3109.0 | 7.1041 | 0.193 16 | 3106.7 | 7.0671 | 330 |
| 340 | 0.230 44 | 3132.7 | 7.1792 | 0.212 29 | 3130.6 | 7.1396 | 0.196 73 | 3128.4 | 7.1028 | 340 |
| 350 | 0.234 54 | 3154.1 | 7.2138 | 0.216 09 | 3152.1 | 7.1745 | 0.200 28 | 3150.1 | 7.1378 | 350 |
| 360 | 0.238 62 | 3175.6 | 7.2479 | 0.219 88 | 3173.6 | 7.2087 | 0.203 82 | 3171.7 | 7.1722 | 360 |
| 370 | 0.242 69 | 3197.0 | 7.2815 | 0.223 65 | 3195.1 | 7.2424 | 0.207 33 | 3193.3 | 7.2061 | 370 |
| 380 | 0.246 74 | 3218.4 | 7.3145 | 0.227 41 | 3216.6 | 7.2756 | 0.210 84 | 3214.9 | 7.2394 | 380 |
| 390 | 0.250 78 | 3239.8 | 7.3470 | 0.231 15 | 3238.1 | 7.3082 | 0.214 33 | 3236.4 | 7.2721 | 390 |
| 400 | 0.254 81 | 3261.2 | 7.3791 | 0.234 89 | 3259.6 | 7.3404 | 0.217 81 | 3258.0 | 7.3044 | 400 |
| 410 | 0.258 82 | 3282.6 | 7.4107 | 0.238 61 | 3281.1 | 7.3721 | 0.221 28 | 3279.5 | 7.3362 | 410 |
| 420 | 0.262 83 | 3304.1 | 7.4419 | 0.242 32 | 3302.6 | 7.4033 | 0.224 74 | 3301.1 | 7.3675 | 420 |
| 430 | 0.266 83 | 3325.5 | 7.4726 | 0.246 03 | 3324.1 | 7.4342 | 0.228 19 | 3322.7 | 7.3985 | 430 |
| 440 | 0.270 82 | 3347.0 | 7.5030 | 0.249 72 | 3345.7 | 7.4646 | 0.231 64 | 3344.3 | 7.4290 | 440 |
| 450 | 0.274 81 | 3368.6 | 7.5330 | 0.253 41 | 3367.3 | 7.4947 | 0.235 07 | 3366.0 | 7.4591 | 450 |
| 460 | 0.278 79 | 3390.2 | 7.5626 | 0.257 09 | 3388.9 | 7.5244 | 0.238 50 | 3387.6 | 7.4889 | 460 |
| 470 | 0.282 76 | 3411.8 | 7.5919 | 0.260 77 | 3410.5 | 7.5537 | 0.241 92 | 3409.3 | 7.5183 | 470 |
| 480 | 0.286 72 | 3433.4 | 7.6208 | 0.264 44 | 3432.2 | 7.5827 | 0.245 34 | 3431.1 | 7.5473 | 480 |
| 490 | 0.290 68 | 3455.1 | 7.6494 | 0.268 10 | 3454.0 | 7.6114 | 0.248 75 | 3452.8 | 7.5761 | 490 |
| 500 | 0.294 64 | 3476.8 | 7.6777 | 0.271 76 | 3475.7 | 7.6397 | 0.252 15 | 3474.7 | 7.6045 | 500 |
| 510 | 0.298 58 | 3498.6 | 7.7057 | 0.275 41 | 3497.6 | 7.6678 | 0.255 55 | 3496.5 | 7.6325 | 510 |
| 520 | 0.302 53 | 3520.4 | 7.7334 | 0.279 06 | 3519.4 | 7.6955 | 0.258 95 | 3518.4 | 7.6603 | 520 |
| 530 | 0.306 47 | 3542.3 | 7.7608 | 0.282 71 | 3541.3 | 7.7230 | 0.262 34 | 3540.4 | 7.6878 | 530 |
| 540 | 0.310 40 | 3564.3 | 7.7880 | 0.286 35 | 3563.3 | 7.7501 | 0.265 73 | 3562.4 | 7.7151 | 540 |
| 550 | 0.314 34 | 3586.2 | 7.8148 | 0.289 98 | 3585.3 | 7.7770 | 0.269 11 | 3584.4 | 7.7420 | 550 |
| 560 | 0.318 27 | 3608.3 | 7.8414 | 0.293 62 | 3607.4 | 7.8037 | 0.272 49 | 3606.5 | 7.7687 | 560 |
| 570 | 0.322 19 | 3630.4 | 7.8678 | 0.297 24 | 3629.5 | 7.8301 | 0.275 86 | 3628.7 | 7.7951 | 570 |
| 580 | 0.326 11 | 3652.5 | 7.8939 | 0.300 87 | 3651.7 | 7.8562 | 0.279 24 | 3650.9 | 7.8213 | 580 |
| 590 | 0.330 03 | 3674.7 | 7.9198 | 0.304 49 | 3673.9 | 7.8821 | 0.282 60 | 3673.1 | 7.8472 | 590 |
| 600 | 0.333 95 | 3697.0 | 7.9454 | 0.308 11 | 3696.2 | 7.9078 | 0.285 97 | 3695.4 | 7.8729 | 600 |
| 610 | 0.337 86 | 3719.3 | 7.9709 | 0.311 73 | 3718.6 | 7.9333 | 0.289 33 | 3717.8 | 7.8984 | 610 |
| 620 | 0.341 77 | 3741.7 | 7.9961 | 0.315 35 | 3741.0 | 7.9585 | 0.292 70 | 3740.2 | 7.9236 | 620 |
| 630 | 0.345 68 | 3764.1 | 8.0210 | 0.318 96 | 3763.4 | 7.9835 | 0.296 05 | 3762.7 | 7.9487 | 630 |
| 640 | 0.349 58 | 3786.6 | 8.0458 | 0.322 57 | 3785.9 | 8.0083 | 0.299 41 | 3785.2 | 7.9735 | 640 |
| 650 | 0.353 49 | 3809.2 | 8.0704 | 0.326 17 | 3808.5 | 8.0329 | 0.302 76 | 3807.8 | 7.9981 | 650 |
| 660 | 0.357 39 | 3831.8 | 8.0948 | 0.329 78 | 3831.2 | 8.0573 | 0.306 12 | 3830.5 | 8.0225 | 660 |
| 670 | 0.361 29 | 3854.5 | 8.1190 | 0.333 38 | 3853.9 | 8.0815 | 0.309 47 | 3853.2 | 8.0468 | 670 |
| 680 | 0.365 18 | 3877.3 | 8.1429 | 0.336 98 | 3876.6 | 8.1055 | 0.312 81 | 3876.0 | 8.0708 | 680 |
| 690 | 0.369 08 | 3900.1 | 8.1668 | 0.340 58 | 3899.5 | 8.1293 | 0.316 16 | 3898.9 | 8.0946 | 690 |
| 700 | 0.372 97 | 3922.9 | 8.1904 | 0.344 18 | 3922.4 | 8.1530 | 0.319 50 | 3921.8 | 8.1183 | 700 |
| 710 | 0.376 87 | 3945.9 | 8.2138 | 0.347 78 | 3945.3 | 8.1764 | 0.322 85 | 3944.7 | 8.1418 | 710 |
| 720 | 0.380 76 | 3968.9 | 8.2371 | 0.351 37 | 3968.3 | 8.1997 | 0.326 19 | 3967.8 | 8.1651 | 720 |
| 730 | 0.384 64 | 3992.0 | 8.2602 | 0.354 97 | 3991.4 | 8.2229 | 0.329 53 | 3990.9 | 8.1882 | 730 |
| 740 | 0.388 53 | 4015.1 | 8.2832 | 0.358 56 | 4014.6 | 8.2458 | 0.332 87 | 4014.0 | 8.2112 | 740 |
| 750 | 0.392 42 | 4038.3 | 8.3059 | 0.362 15 | 4037.8 | 8.2686 | 0.336 20 | 4037.2 | 8.2340 | 750 |
| 760 | 0.396 30 | 4061.5 | 8.3286 | 0.365 74 | 4061.0 | 8.2912 | 0.339 54 | 4060.5 | 8.2567 | 760 |
| 770 | 0.400 19 | 4084.9 | 8.3510 | 0.369 33 | 4084.4 | 8.3137 | 0.342 87 | 4083.9 | 8.2791 | 770 |
| 780 | 0.404 07 | 4108.3 | 8.3734 | 0.372 91 | 4107.8 | 8.3360 | 0.346 21 | 4107.3 | 8.3015 | 780 |
| 790 | 0.407 95 | 4131.7 | 8.3955 | 0.376 50 | 4131.2 | 8.3582 | 0.349 54 | 4130.8 | 8.3237 | 790 |
| 800 | 0.411 84 | 4155.2 | 8.4175 | 0.380 09 | 4154.8 | 8.3803 | 0.352 88 | 4154.3 | 8.3457 | 800 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 1.5 MPa ($t_{sat}$ = 198.30 °C) | | | 1.6 MPa ($t_{sat}$ = 201.38 °C) | | | 1.7 MPa ($t_{sat}$ = 204.31 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| Sat. Liq. | 0.001 153 9 | 844.72 | 2.3147 | 0.001 158 7 | 858.61 | 2.3438 | 0.001 163 4 | 871.89 | 2.3715 | Sat. Liq. |
| Sat. Vap. | 0.131 70 | 2791.0 | 6.4431 | 0.123 73 | 2792.9 | 6.4200 | 0.116 67 | 2794.5 | 6.3983 | Sat. Vap. |
| 0 | 0.000 999 4 | 1.48 | -0.0001 | 0.000 999 4 | 1.59 | -0.0001 | 0.000 999 3 | 1.69 | 0.0000 | 0 |
| 5 | 0.000 999 3 | 22.51 | 0.0762 | 0.000 999 3 | 22.61 | 0.0762 | 0.000 999 2 | 22.71 | 0.0762 | 5 |
| 10 | 0.000 999 6 | 43.48 | 0.1510 | 0.000 999 6 | 43.58 | 0.1509 | 0.000 999 5 | 43.68 | 0.1509 | 10 |
| 15 | 0.001 000 2 | 64.42 | 0.2242 | 0.001 000 2 | 64.51 | 0.2242 | 0.001 000 2 | 64.61 | 0.2242 | 15 |
| 20 | 0.001 001 2 | 85.33 | 0.2962 | 0.001 001 1 | 85.42 | 0.2962 | 0.001 001 1 | 85.52 | 0.2961 | 20 |
| 25 | 0.001 002 3 | 106.22 | 0.3669 | 0.001 002 3 | 106.32 | 0.3668 | 0.001 002 2 | 106.41 | 0.3668 | 25 |
| 30 | 0.001 003 7 | 127.11 | 0.4363 | 0.001 003 7 | 127.20 | 0.4363 | 0.001 003 7 | 127.29 | 0.4363 | 30 |
| 35 | 0.001 005 4 | 147.99 | 0.5046 | 0.001 005 3 | 148.08 | 0.5046 | 0.001 005 3 | 148.17 | 0.5046 | 35 |
| 40 | 0.001 007 2 | 168.86 | 0.5719 | 0.001 007 2 | 168.95 | 0.5718 | 0.001 007 1 | 169.04 | 0.5718 | 40 |
| 45 | 0.001 009 3 | 189.74 | 0.6380 | 0.001 009 2 | 189.83 | 0.6379 | 0.001 009 2 | 189.91 | 0.6379 | 45 |
| 50 | 0.001 011 5 | 210.62 | 0.7031 | 0.001 011 4 | 210.71 | 0.7031 | 0.001 011 4 | 210.79 | 0.7030 | 50 |
| 55 | 0.001 013 9 | 231.50 | 0.7672 | 0.001 013 8 | 231.59 | 0.7672 | 0.001 013 8 | 231.67 | 0.7671 | 55 |
| 60 | 0.001 016 4 | 252.40 | 0.8304 | 0.001 016 4 | 252.48 | 0.8304 | 0.001 016 4 | 252.57 | 0.8303 | 60 |
| 65 | 0.001 019 2 | 273.30 | 0.8927 | 0.001 019 1 | 273.38 | 0.8927 | 0.001 019 1 | 273.47 | 0.8926 | 65 |
| 70 | 0.001 022 1 | 294.22 | 0.9541 | 0.001 022 0 | 294.30 | 0.9541 | 0.001 022 0 | 294.38 | 0.9540 | 70 |
| 75 | 0.001 025 1 | 315.15 | 1.0147 | 0.001 025 1 | 315.23 | 1.0146 | 0.001 025 0 | 315.31 | 1.0146 | 75 |
| 80 | 0.001 028 4 | 336.10 | 1.0744 | 0.001 028 3 | 336.18 | 1.0744 | 0.001 028 3 | 336.26 | 1.0743 | 80 |
| 85 | 0.001 031 7 | 357.08 | 1.1334 | 0.001 031 7 | 357.16 | 1.1333 | 0.001 031 6 | 357.24 | 1.1333 | 85 |
| 90 | 0.001 035 2 | 378.07 | 1.1916 | 0.001 035 2 | 378.15 | 1.1916 | 0.001 035 1 | 378.23 | 1.1915 | 90 |
| 95 | 0.001 038 9 | 399.10 | 1.2491 | 0.001 038 9 | 399.17 | 1.2490 | 0.001 038 8 | 399.25 | 1.2490 | 95 |
| 100 | 0.001 042 7 | 420.15 | 1.3059 | 0.001 042 7 | 420.23 | 1.3058 | 0.001 042 6 | 420.30 | 1.3058 | 100 |
| 105 | 0.001 046 7 | 441.23 | 1.3620 | 0.001 046 7 | 441.31 | 1.3620 | 0.001 046 6 | 441.38 | 1.3619 | 105 |
| 110 | 0.001 050 9 | 462.35 | 1.4175 | 0.001 050 8 | 462.42 | 1.4174 | 0.001 050 8 | 462.50 | 1.4174 | 110 |
| 115 | 0.001 055 1 | 483.51 | 1.4724 | 0.001 055 1 | 483.58 | 1.4723 | 0.001 055 0 | 483.65 | 1.4722 | 115 |
| 120 | 0.001 059 6 | 504.70 | 1.5266 | 0.001 059 5 | 504.77 | 1.5265 | 0.001 059 5 | 504.84 | 1.5265 | 120 |
| 125 | 0.001 064 2 | 525.94 | 1.5803 | 0.001 064 1 | 526.01 | 1.5802 | 0.001 064 1 | 526.07 | 1.5801 | 125 |
| 130 | 0.001 069 0 | 547.22 | 1.6334 | 0.001 068 9 | 547.29 | 1.6333 | 0.001 068 9 | 547.36 | 1.6332 | 130 |
| 135 | 0.001 073 9 | 568.55 | 1.6860 | 0.001 073 9 | 568.62 | 1.6859 | 0.001 073 8 | 568.69 | 1.6858 | 135 |
| 140 | 0.001 079 0 | 589.94 | 1.7381 | 0.001 079 0 | 590.00 | 1.7380 | 0.001 078 9 | 590.07 | 1.7379 | 140 |
| 145 | 0.001 084 3 | 611.38 | 1.7897 | 0.001 084 3 | 611.44 | 1.7896 | 0.001 084 2 | 611.51 | 1.7895 | 145 |
| 150 | 0.001 089 8 | 632.88 | 1.8408 | 0.001 089 7 | 632.95 | 1.8407 | 0.001 089 7 | 633.01 | 1.8406 | 150 |
| 155 | 0.001 095 5 | 654.45 | 1.8915 | 0.001 095 4 | 654.51 | 1.8914 | 0.001 095 3 | 654.57 | 1.8912 | 155 |
| 160 | 0.001 101 3 | 676.09 | 1.9417 | 0.001 101 3 | 676.15 | 1.9416 | 0.001 101 2 | 676.21 | 1.9415 | 160 |
| 165 | 0.001 107 4 | 697.80 | 1.9916 | 0.001 107 3 | 697.86 | 1.9914 | 0.001 107 3 | 697.91 | 1.9913 | 165 |
| 170 | 0.001 113 7 | 719.59 | 2.0410 | 0.001 113 6 | 719.65 | 2.0409 | 0.001 113 6 | 719.70 | 2.0408 | 170 |
| 175 | 0.001 120 2 | 741.47 | 2.0901 | 0.001 120 1 | 741.52 | 2.0900 | 0.001 120 1 | 741.58 | 2.0898 | 175 |
| 180 | 0.001 127 0 | 763.44 | 2.1389 | 0.001 126 9 | 763.49 | 2.1387 | 0.001 126 8 | 763.54 | 2.1386 | 180 |
| 185 | 0.001 134 0 | 785.51 | 2.1873 | 0.001 133 9 | 785.55 | 2.1871 | 0.001 133 8 | 785.60 | 2.1870 | 185 |
| 190 | 0.001 141 2 | 807.68 | 2.2354 | 0.001 141 1 | 807.72 | 2.2353 | 0.001 141 0 | 807.77 | 2.2351 | 190 |
| 195 | 0.001 148 7 | 829.96 | 2.2833 | 0.001 148 6 | 830.01 | 2.2831 | 0.001 148 6 | 830.05 | 2.2830 | 195 |
| 200 | 0.132 44 | 2796.0 | 6.4537 | 0.001 156 5 | 852.41 | 2.3307 | 0.001 156 4 | 852.45 | 2.3306 | 200 |
| 205 | 0.134 56 | 2810.2 | 6.4835 | 0.125 21 | 2803.6 | 6.4425 | 0.116 94 | 2796.6 | 6.4026 | 205 |
| 210 | 0.136 62 | 2823.9 | 6.5120 | 0.127 20 | 2817.7 | 6.4720 | 0.118 87 | 2811.4 | 6.4333 | 210 |
| 215 | 0.138 65 | 2837.2 | 6.5394 | 0.129 15 | 2831.4 | 6.5002 | 0.120 75 | 2825.5 | 6.4625 | 215 |
| 220 | 0.140 63 | 2850.2 | 6.5658 | 0.131 05 | 2844.8 | 6.5273 | 0.122 58 | 2839.2 | 6.4904 | 220 |
| 225 | 0.142 58 | 2862.9 | 6.5915 | 0.132 92 | 2857.8 | 6.5536 | 0.124 37 | 2852.6 | 6.5173 | 225 |
| 230 | 0.144 51 | 2875.5 | 6.6166 | 0.134 76 | 2870.6 | 6.5792 | 0.126 14 | 2865.6 | 6.5434 | 230 |
| 235 | 0.146 41 | 2887.8 | 6.6410 | 0.136 57 | 2883.2 | 6.6041 | 0.127 88 | 2878.5 | 6.5688 | 235 |
| 240 | 0.148 30 | 2900.0 | 6.6649 | 0.138 36 | 2895.6 | 6.6284 | 0.129 59 | 2891.1 | 6.5936 | 240 |
| 245 | 0.150 16 | 2912.0 | 6.6882 | 0.140 13 | 2907.8 | 6.6521 | 0.131 28 | 2903.6 | 6.6177 | 245 |
| 250 | 0.152 00 | 2924.0 | 6.7111 | 0.141 89 | 2919.9 | 6.6754 | 0.132 95 | 2915.9 | 6.6413 | 250 |
| 255 | 0.153 83 | 2935.8 | 6.7336 | 0.143 62 | 2931.9 | 6.6981 | 0.134 61 | 2928.0 | 6.6644 | 255 |
| 260 | 0.155 64 | 2947.5 | 6.7556 | 0.145 34 | 2943.8 | 6.7205 | 0.136 25 | 2940.0 | 6.6870 | 260 |
| 265 | 0.157 43 | 2959.1 | 6.7773 | 0.147 05 | 2955.5 | 6.7424 | 0.137 87 | 2951.9 | 6.7093 | 265 |
| 270 | 0.159 22 | 2970.6 | 6.7986 | 0.148 74 | 2967.2 | 6.7639 | 0.139 48 | 2963.7 | 6.7311 | 270 |

**UNITS**: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 1.5 MPa ($t_{sat}$ = 198.30 °C) | | | 1.6 MPa ($t_{sat}$ = 201.38 °C) | | | 1.7 MPa ($t_{sat}$ = 204.31 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| 275 | 0.160 99 | 2982.0 | 6.8195 | 0.150 42 | 2978.7 | 6.7851 | 0.141 08 | 2975.4 | 6.7525 | 275 |
| 280 | 0.162 75 | 2993.4 | 6.8402 | 0.152 08 | 2990.2 | 6.8060 | 0.142 67 | 2987.0 | 6.7736 | 280 |
| 285 | 0.164 50 | 3004.7 | 6.8605 | 0.153 74 | 3001.6 | 6.8265 | 0.144 24 | 2998.5 | 6.7943 | 285 |
| 290 | 0.166 24 | 3015.9 | 6.8806 | 0.155 39 | 3013.0 | 6.8468 | 0.145 81 | 3010.0 | 6.8148 | 290 |
| 295 | 0.167 98 | 3027.1 | 6.9004 | 0.157 03 | 3024.3 | 6.8668 | 0.147 36 | 3021.4 | 6.8349 | 295 |
| 300 | 0.169 70 | 3038.3 | 6.9199 | 0.158 66 | 3035.5 | 6.8865 | 0.148 91 | 3032.7 | 6.8548 | 300 |
| 310 | 0.173 12 | 3060.4 | 6.9582 | 0.161 89 | 3057.9 | 6.9251 | 0.151 98 | 3055.3 | 6.8938 | 310 |
| 320 | 0.176 52 | 3082.5 | 6.9957 | 0.165 10 | 3080.0 | 6.9628 | 0.155 02 | 3077.6 | 6.9318 | 320 |
| 330 | 0.179 89 | 3104.4 | 7.0324 | 0.168 28 | 3102.1 | 6.9997 | 0.158 03 | 3099.8 | 6.9689 | 330 |
| 340 | 0.183 25 | 3126.3 | 7.0683 | 0.171 44 | 3124.1 | 7.0359 | 0.161 03 | 3121.9 | 7.0052 | 340 |
| 350 | 0.186 58 | 3148.0 | 7.1035 | 0.174 58 | 3146.0 | 7.0713 | 0.164 00 | 3143.9 | 7.0408 | 350 |
| 360 | 0.189 89 | 3169.8 | 7.1381 | 0.177 71 | 3167.8 | 7.1060 | 0.166 96 | 3165.8 | 7.0757 | 360 |
| 370 | 0.193 19 | 3191.4 | 7.1721 | 0.180 82 | 3189.6 | 7.1401 | 0.169 90 | 3187.7 | 7.1100 | 370 |
| 380 | 0.196 48 | 3213.1 | 7.2055 | 0.183 91 | 3211.3 | 7.1737 | 0.172 82 | 3209.5 | 7.1437 | 380 |
| 390 | 0.199 75 | 3234.7 | 7.2384 | 0.186 99 | 3233.0 | 7.2067 | 0.175 73 | 3231.3 | 7.1768 | 390 |
| 400 | 0.203 01 | 3256.4 | 7.2708 | 0.190 06 | 3254.7 | 7.2392 | 0.178 64 | 3253.1 | 7.2094 | 400 |
| 410 | 0.206 26 | 3278.0 | 7.3027 | 0.193 12 | 3276.4 | 7.2712 | 0.181 53 | 3274.9 | 7.2415 | 410 |
| 420 | 0.209 50 | 3299.6 | 7.3341 | 0.196 17 | 3298.2 | 7.3027 | 0.184 41 | 3296.7 | 7.2731 | 420 |
| 430 | 0.212 74 | 3321.3 | 7.3651 | 0.199 21 | 3319.9 | 7.3338 | 0.187 28 | 3318.4 | 7.3043 | 430 |
| 440 | 0.215 96 | 3343.0 | 7.3957 | 0.202 24 | 3341.6 | 7.3645 | 0.190 14 | 3340.2 | 7.3351 | 440 |
| 450 | 0.219 18 | 3364.7 | 7.4259 | 0.205 27 | 3363.3 | 7.3948 | 0.192 99 | 3362.0 | 7.3654 | 450 |
| 460 | 0.222 38 | 3386.4 | 7.4558 | 0.208 28 | 3385.1 | 7.4247 | 0.195 84 | 3383.8 | 7.3954 | 460 |
| 470 | 0.225 59 | 3408.1 | 7.4852 | 0.211 29 | 3406.9 | 7.4542 | 0.198 68 | 3405.7 | 7.4250 | 470 |
| 480 | 0.228 78 | 3429.9 | 7.5143 | 0.214 30 | 3428.7 | 7.4834 | 0.201 52 | 3427.5 | 7.4542 | 480 |
| 490 | 0.231 97 | 3451.7 | 7.5431 | 0.217 30 | 3450.6 | 7.5122 | 0.204 35 | 3449.4 | 7.4831 | 490 |
| 500 | 0.235 16 | 3473.6 | 7.5716 | 0.220 29 | 3472.5 | 7.5407 | 0.207 17 | 3471.4 | 7.5117 | 500 |
| 510 | 0.238 34 | 3495.5 | 7.5997 | 0.223 28 | 3494.4 | 7.5689 | 0.209 99 | 3493.4 | 7.5399 | 510 |
| 520 | 0.241 52 | 3517.4 | 7.6275 | 0.226 26 | 3516.4 | 7.5968 | 0.212 80 | 3515.4 | 7.5678 | 520 |
| 530 | 0.244 69 | 3539.4 | 7.6551 | 0.229 24 | 3538.4 | 7.6244 | 0.215 61 | 3537.4 | 7.5955 | 530 |
| 540 | 0.247 85 | 3561.4 | 7.6823 | 0.232 22 | 3560.5 | 7.6517 | 0.218 42 | 3559.5 | 7.6228 | 540 |
| 550 | 0.251 02 | 3583.5 | 7.7093 | 0.235 19 | 3582.6 | 7.6787 | 0.221 22 | 3581.6 | 7.6499 | 550 |
| 560 | 0.254 18 | 3605.6 | 7.7360 | 0.238 15 | 3604.7 | 7.7054 | 0.224 02 | 3603.8 | 7.6766 | 560 |
| 570 | 0.257 33 | 3627.8 | 7.7625 | 0.241 12 | 3626.9 | 7.7319 | 0.226 81 | 3626.1 | 7.7032 | 570 |
| 580 | 0.260 48 | 3650.0 | 7.7887 | 0.244 08 | 3649.2 | 7.7582 | 0.229 60 | 3648.3 | 7.7295 | 580 |
| 590 | 0.263 63 | 3672.3 | 7.8147 | 0.247 03 | 3671.5 | 7.7842 | 0.232 39 | 3670.7 | 7.7555 | 590 |
| 600 | 0.266 78 | 3694.6 | 7.8404 | 0.249 99 | 3693.9 | 7.8099 | 0.235 17 | 3693.1 | 7.7813 | 600 |
| 610 | 0.269 92 | 3717.0 | 7.8659 | 0.252 94 | 3716.3 | 7.8355 | 0.237 96 | 3715.5 | 7.8068 | 610 |
| 620 | 0.273 07 | 3739.5 | 7.8912 | 0.255 89 | 3738.7 | 7.8608 | 0.240 73 | 3738.0 | 7.8321 | 620 |
| 630 | 0.276 20 | 3762.0 | 7.9162 | 0.258 84 | 3761.3 | 7.8858 | 0.243 51 | 3760.6 | 7.8573 | 630 |
| 640 | 0.279 34 | 3784.6 | 7.9411 | 0.261 78 | 3783.9 | 7.9107 | 0.246 29 | 3783.2 | 7.8821 | 640 |
| 650 | 0.282 48 | 3807.2 | 7.9657 | 0.264 72 | 3806.5 | 7.9354 | 0.249 06 | 3805.8 | 7.9068 | 650 |
| 660 | 0.285 61 | 3829.9 | 7.9902 | 0.267 66 | 3829.2 | 7.9598 | 0.251 83 | 3828.5 | 7.9313 | 660 |
| 670 | 0.288 74 | 3852.6 | 8.0144 | 0.270 60 | 3852.0 | 7.9841 | 0.254 60 | 3851.3 | 7.9556 | 670 |
| 680 | 0.291 87 | 3875.4 | 8.0384 | 0.273 54 | 3874.8 | 8.0082 | 0.257 36 | 3874.2 | 7.9797 | 680 |
| 690 | 0.294 99 | 3898.3 | 8.0623 | 0.276 47 | 3897.7 | 8.0320 | 0.260 13 | 3897.1 | 8.0036 | 690 |
| 700 | 0.298 12 | 3921.2 | 8.0860 | 0.279 40 | 3920.6 | 8.0557 | 0.262 89 | 3920.0 | 8.0273 | 700 |
| 710 | 0.301 24 | 3944.2 | 8.1095 | 0.282 33 | 3943.6 | 8.0792 | 0.265 65 | 3943.0 | 8.0508 | 710 |
| 720 | 0.304 36 | 3967.2 | 8.1328 | 0.285 26 | 3966.7 | 8.1026 | 0.268 41 | 3966.1 | 8.0742 | 720 |
| 730 | 0.307 48 | 3990.3 | 8.1560 | 0.288 19 | 3989.8 | 8.1258 | 0.271 17 | 3989.2 | 8.0973 | 730 |
| 740 | 0.310 60 | 4013.5 | 8.1789 | 0.291 12 | 4013.0 | 8.1488 | 0.273 93 | 4012.4 | 8.1204 | 740 |
| 750 | 0.313 72 | 4036.7 | 8.2018 | 0.294 04 | 4036.2 | 8.1716 | 0.276 68 | 4035.7 | 8.1432 | 750 |
| 760 | 0.316 83 | 4060.0 | 8.2244 | 0.296 96 | 4059.5 | 8.1943 | 0.279 43 | 4059.0 | 8.1659 | 760 |
| 770 | 0.319 95 | 4083.4 | 8.2469 | 0.299 89 | 4082.9 | 8.2168 | 0.282 19 | 4082.4 | 8.1884 | 770 |
| 780 | 0.323 06 | 4106.8 | 8.2693 | 0.302 81 | 4106.3 | 8.2391 | 0.284 94 | 4105.9 | 8.2108 | 780 |
| 790 | 0.326 17 | 4130.3 | 8.2915 | 0.305 73 | 4129.8 | 8.2613 | 0.287 69 | 4129.4 | 8.2330 | 790 |
| 800 | 0.329 29 | 4153.9 | 8.3135 | 0.308 65 | 4153.4 | 8.2834 | 0.290 44 | 4153.0 | 8.2551 | 800 |

UNITS: $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 1.8 MPa ($t_{sat}$ = 207.12 °C) | | | 2.0 MPa ($t_{sat}$ = 212.38 °C) | | | 2.2 MPa ($t_{sat}$ = 217.26 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 167 9 | 884.61 | 2.3978 | 0.001 176 8 | 908.62 | 2.4470 | 0.001 185 2 | 930.98 | 2.4924 | Sat. Liq. |
| Sat. Vap. | 0.110 36 | 2796.0 | 6.3776 | 0.099 58 | 2798.4 | 6.3392 | 0.090 70 | 2800.2 | 6.3040 | Sat. Vap. |
| 0 | 0.000 999 3 | 1.79 | 0.0000 | 0.000 999 2 | 1.99 | 0.0000 | 0.000 999 1 | 2.20 | 0.0000 | 0 |
| 5 | 0.000 999 2 | 22.81 | 0.0762 | 0.000 999 1 | 23.01 | 0.0762 | 0.000 999 0 | 23.21 | 0.0762 | 5 |
| 10 | 0.000 999 5 | 43.77 | 0.1509 | 0.000 999 4 | 43.97 | 0.1509 | 0.000 999 3 | 44.16 | 0.1509 | 10 |
| 15 | 0.001 000 1 | 64.70 | 0.2242 | 0.001 000 0 | 64.89 | 0.2242 | 0.000 999 9 | 65.09 | 0.2241 | 15 |
| 20 | 0.001 001 0 | 85.61 | 0.2961 | 0.001 000 9 | 85.80 | 0.2961 | 0.001 000 8 | 85.99 | 0.2960 | 20 |
| 25 | 0.001 002 2 | 106.50 | 0.3668 | 0.001 002 1 | 106.69 | 0.3667 | 0.001 002 0 | 106.87 | 0.3667 | 25 |
| 30 | 0.001 003 6 | 127.38 | 0.4362 | 0.001 003 5 | 127.56 | 0.4362 | 0.001 003 4 | 127.75 | 0.4361 | 30 |
| 35 | 0.001 005 2 | 148.26 | 0.5045 | 0.001 005 2 | 148.44 | 0.5045 | 0.001 005 1 | 148.62 | 0.5044 | 35 |
| 40 | 0.001 007 1 | 169.13 | 0.5717 | 0.001 007 0 | 169.31 | 0.5717 | 0.001 006 9 | 169.48 | 0.5716 | 40 |
| 45 | 0.001 009 1 | 190.00 | 0.6379 | 0.001 009 0 | 190.18 | 0.6378 | 0.001 008 9 | 190.35 | 0.6377 | 45 |
| 50 | 0.001 011 3 | 210.88 | 0.7030 | 0.001 011 3 | 211.05 | 0.7029 | 0.001 011 2 | 211.22 | 0.7028 | 50 |
| 55 | 0.001 013 7 | 231.76 | 0.7671 | 0.001 013 7 | 231.93 | 0.7670 | 0.001 013 6 | 232.10 | 0.7669 | 55 |
| 60 | 0.001 016 3 | 252.65 | 0.8303 | 0.001 016 2 | 252.82 | 0.8302 | 0.001 016 1 | 252.98 | 0.8301 | 60 |
| 65 | 0.001 019 0 | 273.55 | 0.8925 | 0.001 019 0 | 273.72 | 0.8924 | 0.001 018 9 | 273.88 | 0.8923 | 65 |
| 70 | 0.001 021 9 | 294.46 | 0.9539 | 0.001 021 9 | 294.63 | 0.9538 | 0.001 021 8 | 294.79 | 0.9537 | 70 |
| 75 | 0.001 025 0 | 315.39 | 1.0145 | 0.001 024 9 | 315.56 | 1.0144 | 0.001 024 8 | 315.72 | 1.0142 | 75 |
| 80 | 0.001 028 2 | 336.34 | 1.0742 | 0.001 028 1 | 336.50 | 1.0741 | 0.001 028 0 | 336.66 | 1.0740 | 80 |
| 85 | 0.001 031 6 | 357.31 | 1.1332 | 0.001 031 5 | 357.47 | 1.1331 | 0.001 031 4 | 357.63 | 1.1329 | 85 |
| 90 | 0.001 035 1 | 378.31 | 1.1914 | 0.001 035 0 | 378.46 | 1.1913 | 0.001 034 9 | 378.62 | 1.1911 | 90 |
| 95 | 0.001 038 8 | 399.33 | 1.2489 | 0.001 038 7 | 399.48 | 1.2487 | 0.001 038 6 | 399.63 | 1.2486 | 95 |
| 100 | 0.001 042 6 | 420.38 | 1.3057 | 0.001 042 5 | 420.53 | 1.3055 | 0.001 042 4 | 420.68 | 1.3054 | 100 |
| 105 | 0.001 046 6 | 441.46 | 1.3618 | 0.001 046 5 | 441.60 | 1.3616 | 0.001 046 4 | 441.75 | 1.3615 | 105 |
| 110 | 0.001 050 7 | 462.57 | 1.4173 | 0.001 050 6 | 462.71 | 1.4171 | 0.001 050 5 | 462.86 | 1.4169 | 110 |
| 115 | 0.001 055 0 | 483.72 | 1.4721 | 0.001 054 9 | 483.86 | 1.4719 | 0.001 054 8 | 484.01 | 1.4718 | 115 |
| 120 | 0.001 059 4 | 504.91 | 1.5264 | 0.001 059 3 | 505.05 | 1.5262 | 0.001 059 2 | 505.19 | 1.5260 | 120 |
| 125 | 0.001 064 0 | 526.14 | 1.5800 | 0.001 063 9 | 526.28 | 1.5798 | 0.001 063 8 | 526.42 | 1.5797 | 125 |
| 130 | 0.001 068 8 | 547.42 | 1.6331 | 0.001 068 7 | 547.56 | 1.6329 | 0.001 068 6 | 547.69 | 1.6328 | 130 |
| 135 | 0.001 073 7 | 568.75 | 1.6857 | 0.001 073 6 | 568.88 | 1.6855 | 0.001 073 5 | 569.02 | 1.6853 | 135 |
| 140 | 0.001 078 9 | 590.13 | 1.7378 | 0.001 078 7 | 590.26 | 1.7376 | 0.001 078 6 | 590.39 | 1.7374 | 140 |
| 145 | 0.001 084 1 | 611.57 | 1.7894 | 0.001 084 0 | 611.70 | 1.7892 | 0.001 083 9 | 611.82 | 1.7889 | 145 |
| 150 | 0.001 089 6 | 633.07 | 1.8405 | 0.001 089 5 | 633.19 | 1.8403 | 0.001 089 3 | 633.32 | 1.8400 | 150 |
| 155 | 0.001 095 3 | 654.63 | 1.8911 | 0.001 095 1 | 654.75 | 1.8909 | 0.001 095 0 | 654.87 | 1.8907 | 155 |
| 160 | 0.001 101 1 | 676.26 | 1.9414 | 0.001 101 0 | 676.38 | 1.9411 | 0.001 100 8 | 676.50 | 1.9409 | 160 |
| 165 | 0.001 107 2 | 697.97 | 1.9912 | 0.001 107 0 | 698.08 | 1.9909 | 0.001 106 9 | 698.20 | 1.9907 | 165 |
| 170 | 0.001 113 5 | 719.76 | 2.0406 | 0.001 113 3 | 719.87 | 2.0404 | 0.001 113 2 | 719.98 | 2.0401 | 170 |
| 175 | 0.001 120 0 | 741.63 | 2.0897 | 0.001 119 8 | 741.73 | 2.0894 | 0.001 119 7 | 741.84 | 2.0892 | 175 |
| 180 | 0.001 126 7 | 763.59 | 2.1384 | 0.001 126 5 | 763.69 | 2.1382 | 0.001 126 4 | 763.79 | 2.1379 | 180 |
| 185 | 0.001 133 7 | 785.65 | 2.1869 | 0.001 133 5 | 785.75 | 2.1866 | 0.001 133 3 | 785.84 | 2.1863 | 185 |
| 190 | 0.001 140 9 | 807.81 | 2.2350 | 0.001 140 8 | 807.91 | 2.2347 | 0.001 140 6 | 808.00 | 2.2344 | 190 |
| 195 | 0.001 148 5 | 830.09 | 2.2828 | 0.001 148 3 | 830.18 | 2.2825 | 0.001 148 1 | 830.27 | 2.2822 | 195 |
| 200 | 0.001 156 3 | 852.49 | 2.3304 | 0.001 156 1 | 852.57 | 2.3301 | 0.001 155 9 | 852.65 | 2.3298 | 200 |
| 205 | 0.001 164 4 | 875.02 | 2.3778 | 0.001 164 2 | 875.10 | 2.3774 | 0.001 164 0 | 875.17 | 2.3771 | 205 |
| 210 | 0.111 44 | 2804.8 | 6.3958 | 0.001 172 6 | 897.76 | 2.4246 | 0.001 172 4 | 897.83 | 2.4243 | 210 |
| 215 | 0.113 26 | 2819.4 | 6.4260 | 0.100 49 | 2806.6 | 6.3560 | 0.001 181 2 | 920.64 | 2.4712 | 215 |
| 220 | 0.115 03 | 2833.5 | 6.4548 | 0.102 17 | 2821.7 | 6.3868 | 0.091 58 | 2809.0 | 6.3219 | 220 |
| 225 | 0.116 77 | 2847.2 | 6.4824 | 0.103 80 | 2836.1 | 6.4160 | 0.093 14 | 2824.5 | 6.3531 | 225 |
| 230 | 0.118 47 | 2860.6 | 6.5091 | 0.105 39 | 2850.2 | 6.4440 | 0.094 66 | 2839.3 | 6.3826 | 230 |
| 235 | 0.120 14 | 2873.7 | 6.5350 | 0.106 95 | 2863.8 | 6.4710 | 0.096 14 | 2853.6 | 6.4109 | 235 |
| 240 | 0.121 78 | 2886.6 | 6.5602 | 0.108 49 | 2877.2 | 6.4972 | 0.097 58 | 2867.5 | 6.4382 | 240 |
| 245 | 0.123 41 | 2899.2 | 6.5848 | 0.110 00 | 2890.3 | 6.5226 | 0.099 00 | 2881.1 | 6.4646 | 245 |
| 250 | 0.125 01 | 2911.7 | 6.6087 | 0.111 48 | 2903.2 | 6.5474 | 0.100 39 | 2894.5 | 6.4903 | 250 |
| 255 | 0.126 59 | 2924.0 | 6.6322 | 0.112 95 | 2915.9 | 6.5716 | 0.101 77 | 2907.6 | 6.5152 | 255 |
| 260 | 0.128 16 | 2936.2 | 6.6551 | 0.114 40 | 2928.5 | 6.5952 | 0.103 12 | 2920.5 | 6.5396 | 260 |
| 265 | 0.129 72 | 2948.3 | 6.6776 | 0.115 83 | 2940.9 | 6.6183 | 0.104 46 | 2933.3 | 6.5633 | 265 |
| 270 | 0.131 25 | 2960.2 | 6.6997 | 0.117 25 | 2953.1 | 6.6410 | 0.105 78 | 2945.8 | 6.5866 | 270 |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 1.8 MPa ($t_{sat}$ = 207.12 °C) | | | 2.0 MPa ($t_{sat}$ = 212.38 °C) | | | 2.2 MPa ($t_{sat}$ = 217.26 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 0.132 78 | 2972.0 | 6.7214 | 0.118 65 | 2965.2 | 6.6632 | 0.107 08 | 2958.2 | 6.6093 | 275 |
| 280 | 0.134 29 | 2983.8 | 6.7427 | 0.120 05 | 2977.2 | 6.6850 | 0.108 38 | 2970.5 | 6.6316 | 280 |
| 285 | 0.135 79 | 2995.4 | 6.7637 | 0.121 43 | 2989.1 | 6.7064 | 0.109 66 | 2982.6 | 6.6535 | 285 |
| 290 | 0.137 29 | 3007.0 | 6.7843 | 0.122 79 | 3000.9 | 6.7274 | 0.110 93 | 2994.7 | 6.6749 | 290 |
| 295 | 0.138 77 | 3018.5 | 6.8047 | 0.124 15 | 3012.6 | 6.7481 | 0.112 18 | 3006.6 | 6.6961 | 295 |
| 300 | 0.140 24 | 3029.9 | 6.8247 | 0.125 50 | 3024.3 | 6.7685 | 0.113 43 | 3018.5 | 6.7168 | 300 |
| 310 | 0.143 16 | 3052.6 | 6.8640 | 0.128 17 | 3047.3 | 6.8084 | 0.115 90 | 3041.9 | 6.7574 | 310 |
| 320 | 0.146 06 | 3075.1 | 6.9022 | 0.130 82 | 3070.2 | 6.8472 | 0.118 34 | 3065.1 | 6.7968 | 320 |
| 330 | 0.148 92 | 3097.5 | 6.9396 | 0.133 43 | 3092.8 | 6.8851 | 0.120 75 | 3088.1 | 6.8352 | 330 |
| 340 | 0.151 77 | 3119.7 | 6.9761 | 0.136 02 | 3115.3 | 6.9221 | 0.123 14 | 3110.8 | 6.8726 | 340 |
| 350 | 0.154 59 | 3141.8 | 7.0119 | 0.138 59 | 3137.6 | 6.9582 | 0.125 50 | 3133.4 | 6.9091 | 350 |
| 360 | 0.157 40 | 3163.9 | 7.0470 | 0.141 15 | 3159.9 | 6.9937 | 0.127 85 | 3155.9 | 6.9449 | 360 |
| 370 | 0.160 19 | 3185.8 | 7.0814 | 0.143 68 | 3182.1 | 7.0284 | 0.130 18 | 3178.3 | 6.9800 | 370 |
| 380 | 0.162 96 | 3207.8 | 7.1153 | 0.146 20 | 3204.2 | 7.0625 | 0.132 49 | 3200.5 | 7.0144 | 380 |
| 390 | 0.165 73 | 3229.6 | 7.1485 | 0.148 71 | 3226.2 | 7.0960 | 0.134 79 | 3222.8 | 7.0481 | 390 |
| 400 | 0.168 48 | 3251.5 | 7.1812 | 0.151 21 | 3248.2 | 7.1290 | 0.137 08 | 3244.9 | 7.0813 | 400 |
| 410 | 0.171 22 | 3273.3 | 7.2134 | 0.153 69 | 3270.2 | 7.1614 | 0.139 35 | 3267.1 | 7.1139 | 410 |
| 420 | 0.173 95 | 3295.2 | 7.2452 | 0.156 17 | 3292.2 | 7.1933 | 0.141 62 | 3289.2 | 7.1461 | 420 |
| 430 | 0.176 67 | 3317.0 | 7.2764 | 0.158 63 | 3314.1 | 7.2248 | 0.143 87 | 3311.3 | 7.1777 | 430 |
| 440 | 0.179 38 | 3338.8 | 7.3073 | 0.161 09 | 3336.1 | 7.2558 | 0.146 12 | 3333.3 | 7.2089 | 440 |
| 450 | 0.182 08 | 3360.7 | 7.3377 | 0.163 54 | 3358.1 | 7.2863 | 0.148 36 | 3355.4 | 7.2396 | 450 |
| 460 | 0.184 78 | 3382.6 | 7.3677 | 0.165 98 | 3380.0 | 7.3165 | 0.150 59 | 3377.5 | 7.2699 | 460 |
| 470 | 0.187 47 | 3404.5 | 7.3974 | 0.168 41 | 3402.0 | 7.3463 | 0.152 82 | 3399.5 | 7.2998 | 470 |
| 480 | 0.190 16 | 3426.4 | 7.4267 | 0.170 84 | 3424.0 | 7.3757 | 0.155 04 | 3421.6 | 7.3294 | 480 |
| 490 | 0.192 83 | 3448.3 | 7.4556 | 0.173 26 | 3446.0 | 7.4048 | 0.157 25 | 3443.8 | 7.3585 | 490 |
| 500 | 0.195 51 | 3470.3 | 7.4842 | 0.175 68 | 3468.1 | 7.4335 | 0.159 46 | 3465.9 | 7.3873 | 500 |
| 510 | 0.198 18 | 3492.3 | 7.5125 | 0.178 09 | 3490.2 | 7.4619 | 0.161 66 | 3488.1 | 7.4158 | 510 |
| 520 | 0.200 84 | 3514.3 | 7.5405 | 0.180 50 | 3512.3 | 7.4899 | 0.163 86 | 3510.2 | 7.4440 | 520 |
| 530 | 0.203 50 | 3536.4 | 7.5682 | 0.182 90 | 3534.5 | 7.5177 | 0.166 05 | 3532.5 | 7.4718 | 530 |
| 540 | 0.206 15 | 3558.6 | 7.5955 | 0.185 30 | 3556.6 | 7.5451 | 0.168 24 | 3554.7 | 7.4994 | 540 |
| 550 | 0.208 80 | 3580.7 | 7.6226 | 0.187 69 | 3578.9 | 7.5723 | 0.170 42 | 3577.0 | 7.5266 | 550 |
| 560 | 0.211 45 | 3602.9 | 7.6495 | 0.190 09 | 3601.2 | 7.5992 | 0.172 61 | 3599.4 | 7.5536 | 560 |
| 570 | 0.214 09 | 3625.2 | 7.6760 | 0.192 47 | 3623.5 | 7.6258 | 0.174 78 | 3621.7 | 7.5803 | 570 |
| 580 | 0.216 73 | 3647.5 | 7.7023 | 0.194 86 | 3645.8 | 7.6522 | 0.176 96 | 3644.2 | 7.6067 | 580 |
| 590 | 0.219 37 | 3669.9 | 7.7284 | 0.197 24 | 3668.2 | 7.6783 | 0.179 13 | 3666.6 | 7.6329 | 590 |
| 600 | 0.222 00 | 3692.3 | 7.7542 | 0.199 61 | 3690.7 | 7.7042 | 0.181 30 | 3689.1 | 7.6588 | 600 |
| 610 | 0.224 63 | 3714.7 | 7.7798 | 0.201 99 | 3713.2 | 7.7298 | 0.183 46 | 3711.7 | 7.6845 | 610 |
| 620 | 0.227 26 | 3737.3 | 7.8051 | 0.204 36 | 3735.8 | 7.7552 | 0.185 62 | 3734.3 | 7.7100 | 620 |
| 630 | 0.229 89 | 3759.8 | 7.8303 | 0.206 73 | 3758.4 | 7.7804 | 0.187 78 | 3757.0 | 7.7352 | 630 |
| 640 | 0.232 51 | 3782.5 | 7.8552 | 0.209 10 | 3781.1 | 7.8054 | 0.189 94 | 3779.7 | 7.7602 | 640 |
| 650 | 0.235 13 | 3805.1 | 7.8799 | 0.211 46 | 3803.8 | 7.8301 | 0.192 10 | 3802.4 | 7.7850 | 650 |
| 660 | 0.237 75 | 3827.9 | 7.9044 | 0.213 83 | 3826.6 | 7.8547 | 0.194 25 | 3825.2 | 7.8096 | 660 |
| 670 | 0.240 37 | 3850.7 | 7.9287 | 0.216 19 | 3849.4 | 7.8790 | 0.196 40 | 3848.1 | 7.8340 | 670 |
| 680 | 0.242 99 | 3873.5 | 7.9528 | 0.218 55 | 3872.3 | 7.9032 | 0.198 55 | 3871.0 | 7.8582 | 680 |
| 690 | 0.245 60 | 3896.4 | 7.9767 | 0.220 90 | 3895.2 | 7.9271 | 0.200 70 | 3894.0 | 7.8821 | 690 |
| 700 | 0.248 21 | 3919.4 | 8.0004 | 0.223 26 | 3918.2 | 7.9509 | 0.202 84 | 3917.1 | 7.9059 | 700 |
| 710 | 0.250 82 | 3942.5 | 8.0240 | 0.225 61 | 3941.3 | 7.9744 | 0.204 99 | 3940.2 | 7.9295 | 710 |
| 720 | 0.253 43 | 3965.5 | 8.0473 | 0.227 97 | 3964.4 | 7.9978 | 0.207 13 | 3963.3 | 7.9530 | 720 |
| 730 | 0.256 04 | 3988.7 | 8.0705 | 0.230 32 | 3987.6 | 8.0211 | 0.209 27 | 3986.5 | 7.9762 | 730 |
| 740 | 0.258 64 | 4011.9 | 8.0936 | 0.232 67 | 4010.9 | 8.0441 | 0.211 41 | 4009.8 | 7.9993 | 740 |
| 750 | 0.261 25 | 4035.2 | 8.1164 | 0.235 01 | 4034.2 | 8.0670 | 0.213 55 | 4033.1 | 8.0222 | 750 |
| 760 | 0.263 85 | 4058.5 | 8.1391 | 0.237 36 | 4057.5 | 8.0897 | 0.215 69 | 4056.5 | 8.0450 | 760 |
| 770 | 0.266 45 | 4081.9 | 8.1617 | 0.239 71 | 4080.9 | 8.1123 | 0.217 82 | 4080.0 | 8.0676 | 770 |
| 780 | 0.269 05 | 4105.4 | 8.1841 | 0.242 05 | 4104.4 | 8.1347 | 0.219 96 | 4103.5 | 8.0900 | 780 |
| 790 | 0.271 65 | 4128.9 | 8.2063 | 0.244 39 | 4128.0 | 8.1570 | 0.222 09 | 4127.0 | 8.1123 | 790 |
| 800 | 0.274 26 | 4152.5 | 8.2284 | 0.246 74 | 4151.6 | 8.1791 | 0.224 23 | 4150.7 | 8.1344 | 800 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 2.4 MPa ($t_{sat}$ = 221.80 °C) | | | 2.6 MPa ($t_{sat}$ = 226.05 °C) | | | 2.8 MPa ($t_{sat}$ = 230.06 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 193 4 | 951.95 | 2.5344 | 0.001 201 | 971.74 | 2.5738 | 0.001 209 | 990.50 | 2.6107 | Sat. Liq |
| Sat. Vap. | 0.083 24 | 2801.5 | 6.2714 | 0.076 90 | 2802.5 | 6.2411 | 0.071 43 | 2803.0 | 6.2126 | Sat. Vap |
| **0** | 0.000 999 0 | 2.40 | 0.0000 | 0.000 998 9 | 2.60 | 0.0000 | 0.000 998 8 | 2.80 | 0.0000 | **0** |
| **5** | 0.000 998 9 | 23.40 | 0.0762 | 0.000 998 8 | 23.60 | 0.0762 | 0.000 998 7 | 23.80 | 0.0762 | **5** |
| **10** | 0.000 999 2 | 44.36 | 0.1509 | 0.000 999 1 | 44.55 | 0.1508 | 0.000 999 0 | 44.75 | 0.1508 | **10** |
| **15** | 0.000 999 8 | 65.28 | 0.2241 | 0.000 999 7 | 65.47 | 0.2241 | 0.000 999 6 | 65.66 | 0.2240 | **15** |
| **20** | 0.001 000 7 | 86.17 | 0.2960 | 0.001 000 7 | 86.36 | 0.2960 | 0.001 000 6 | 86.55 | 0.2959 | **20** |
| **25** | 0.001 001 9 | 107.06 | 0.3666 | 0.001 001 8 | 107.24 | 0.3666 | 0.001 001 7 | 107.43 | 0.3665 | **25** |
| **30** | 0.001 003 3 | 127.93 | 0.4361 | 0.001 003 3 | 128.11 | 0.4360 | 0.001 003 2 | 128.29 | 0.4359 | **30** |
| **35** | 0.001 005 0 | 148.80 | 0.5043 | 0.001 004 9 | 148.98 | 0.5043 | 0.001 004 8 | 149.15 | 0.5042 | **35** |
| **40** | 0.001 006 8 | 169.66 | 0.5715 | 0.001 006 7 | 169.84 | 0.5714 | 0.001 006 6 | 170.01 | 0.5713 | **40** |
| **45** | 0.001 008 9 | 190.53 | 0.6376 | 0.001 008 8 | 190.70 | 0.6375 | 0.001 008 7 | 190.88 | 0.6374 | **45** |
| **50** | 0.001 011 1 | 211.39 | 0.7027 | 0.001 011 0 | 211.57 | 0.7026 | 0.001 010 9 | 211.74 | 0.7025 | **50** |
| **55** | 0.001 013 5 | 232.27 | 0.7668 | 0.001 013 4 | 232.44 | 0.7667 | 0.001 013 3 | 232.61 | 0.7666 | **55** |
| **60** | 0.001 016 0 | 253.15 | 0.8300 | 0.001 016 0 | 253.32 | 0.8298 | 0.001 015 9 | 253.49 | 0.8297 | **60** |
| **65** | 0.001 018 8 | 274.05 | 0.8922 | 0.001 018 7 | 274.21 | 0.8921 | 0.001 018 6 | 274.38 | 0.8920 | **65** |
| **70** | 0.001 021 7 | 294.95 | 0.9536 | 0.001 021 6 | 295.12 | 0.9535 | 0.001 021 5 | 295.28 | 0.9533 | **70** |
| **75** | 0.001 024 7 | 315.88 | 1.0141 | 0.001 024 6 | 316.04 | 1.0140 | 0.001 024 5 | 316.20 | 1.0139 | **75** |
| **80** | 0.001 027 9 | 336.82 | 1.0738 | 0.001 027 8 | 336.98 | 1.0737 | 0.001 027 7 | 337.14 | 1.0736 | **80** |
| **85** | 0.001 031 3 | 357.78 | 1.1328 | 0.001 031 2 | 357.94 | 1.1326 | 0.001 031 1 | 358.10 | 1.1325 | **85** |
| **90** | 0.001 034 8 | 378.77 | 1.1910 | 0.001 034 7 | 378.93 | 1.1908 | 0.001 034 6 | 379.08 | 1.1907 | **90** |
| **95** | 0.001 038 5 | 399.78 | 1.2484 | 0.001 038 4 | 399.94 | 1.2483 | 0.001 038 3 | 400.09 | 1.2481 | **95** |
| **100** | 0.001 042 3 | 420.83 | 1.3052 | 0.001 042 2 | 420.98 | 1.3051 | 0.001 042 1 | 421.13 | 1.3049 | **100** |
| **105** | 0.001 046 3 | 441.90 | 1.3613 | 0.001 046 2 | 442.05 | 1.3612 | 0.001 046 0 | 442.20 | 1.3610 | **105** |
| **110** | 0.001 050 4 | 463.01 | 1.4168 | 0.001 050 3 | 463.15 | 1.4166 | 0.001 050 2 | 463.30 | 1.4164 | **110** |
| **115** | 0.001 054 7 | 484.15 | 1.4716 | 0.001 054 5 | 484.29 | 1.4714 | 0.001 054 4 | 484.44 | 1.4712 | **115** |
| **120** | 0.001 059 1 | 505.33 | 1.5258 | 0.001 059 0 | 505.47 | 1.5256 | 0.001 058 9 | 505.61 | 1.5255 | **120** |
| **125** | 0.001 063 7 | 526.56 | 1.5795 | 0.001 063 6 | 526.70 | 1.5793 | 0.001 063 5 | 526.84 | 1.5791 | **125** |
| **130** | 0.001 068 4 | 547.83 | 1.6326 | 0.001 068 3 | 547.97 | 1.6324 | 0.001 068 2 | 548.10 | 1.6322 | **130** |
| **135** | 0.001 073 4 | 569.15 | 1.6851 | 0.001 073 3 | 569.28 | 1.6849 | 0.001 073 1 | 569.42 | 1.6847 | **135** |
| **140** | 0.001 078 5 | 590.52 | 1.7372 | 0.001 078 4 | 590.65 | 1.7370 | 0.001 078 2 | 590.78 | 1.7368 | **140** |
| **145** | 0.001 083 8 | 611.95 | 1.7887 | 0.001 083 6 | 612.08 | 1.7885 | 0.001 083 5 | 612.21 | 1.7883 | **145** |
| **150** | 0.001 089 2 | 633.44 | 1.8398 | 0.001 089 1 | 633.56 | 1.8396 | 0.001 088 9 | 633.69 | 1.8394 | **150** |
| **155** | 0.001 094 9 | 654.99 | 1.8904 | 0.001 094 7 | 655.11 | 1.8902 | 0.001 094 6 | 655.24 | 1.8900 | **155** |
| **160** | 0.001 100 7 | 676.62 | 1.9407 | 0.001 100 6 | 676.73 | 1.9404 | 0.001 100 4 | 676.85 | 1.9402 | **160** |
| **165** | 0.001 106 7 | 698.31 | 1.9905 | 0.001 106 6 | 698.43 | 1.9902 | 0.001 106 4 | 698.54 | 1.9900 | **165** |
| **170** | 0.001 113 0 | 720.09 | 2.0399 | 0.001 112 9 | 720.20 | 2.0396 | 0.001 112 7 | 720.31 | 2.0394 | **170** |
| **175** | 0.001 119 5 | 741.94 | 2.0889 | 0.001 119 3 | 742.05 | 2.0887 | 0.001 119 2 | 742.16 | 2.0884 | **175** |
| **180** | 0.001 126 2 | 763.89 | 2.1376 | 0.001 126 0 | 764.00 | 2.1373 | 0.001 125 9 | 764.10 | 2.1371 | **180** |
| **185** | 0.001 133 2 | 785.94 | 2.1860 | 0.001 133 0 | 786.04 | 2.1857 | 0.001 132 8 | 786.13 | 2.1854 | **185** |
| **190** | 0.001 140 4 | 808.09 | 2.2341 | 0.001 140 2 | 808.18 | 2.2338 | 0.001 140 0 | 808.27 | 2.2335 | **190** |
| **195** | 0.001 147 9 | 830.35 | 2.2819 | 0.001 147 7 | 830.44 | 2.2816 | 0.001 147 5 | 830.53 | 2.2813 | **195** |
| **200** | 0.001 155 7 | 852.73 | 2.3295 | 0.001 155 5 | 852.82 | 2.3291 | 0.001 155 2 | 852.90 | 2.3288 | **200** |
| **205** | 0.001 163 7 | 875.25 | 2.3768 | 0.001 163 5 | 875.32 | 2.3765 | 0.001 163 3 | 875.40 | 2.3761 | **205** |
| **210** | 0.001 172 2 | 897.90 | 2.4239 | 0.001 171 9 | 897.97 | 2.4236 | 0.001 171 7 | 898.03 | 2.4232 | **210** |
| **215** | 0.001 180 9 | 920.70 | 2.4709 | 0.001 180 7 | 920.76 | 2.4705 | 0.001 180 4 | 920.82 | 2.4701 | **215** |
| **220** | 0.001 190 1 | 943.66 | 2.5177 | 0.001 189 8 | 943.72 | 2.5173 | 0.001 189 6 | 943.77 | 2.5169 | **220** |
| **225** | 0.084 21 | 2812.1 | 6.2926 | 0.001 199 3 | 966.85 | 2.5640 | 0.001 199 1 | 966.90 | 2.5636 | **225** |
| **230** | 0.085 67 | 2827.8 | 6.3241 | 0.078 02 | 2815.7 | 6.2675 | 0.001 209 | 990.21 | 2.6101 | **230** |
| **235** | 0.087 08 | 2842.9 | 6.3539 | 0.079 39 | 2831.7 | 6.2991 | 0.072 75 | 2819.9 | 6.2460 | **235** |
| **240** | 0.088 46 | 2857.5 | 6.3824 | 0.080 71 | 2847.0 | 6.3291 | 0.074 04 | 2836.1 | 6.2776 | **240** |
| **245** | 0.089 81 | 2871.6 | 6.4099 | 0.082 01 | 2861.8 | 6.3578 | 0.075 29 | 2851.6 | 6.3077 | **245** |
| **250** | 0.091 13 | 2885.5 | 6.4365 | 0.083 27 | 2876.2 | 6.3854 | 0.076 51 | 2866.5 | 6.3365 | **250** |
| **255** | 0.092 43 | 2899.0 | 6.4623 | 0.084 50 | 2890.2 | 6.4121 | 0.077 69 | 2881.1 | 6.3642 | **255** |
| **260** | 0.093 70 | 2912.4 | 6.4874 | 0.085 72 | 2904.0 | 6.4380 | 0.078 85 | 2895.3 | 6.3910 | **260** |
| **265** | 0.094 96 | 2925.5 | 6.5118 | 0.086 91 | 2917.4 | 6.4632 | 0.079 99 | 2909.2 | 6.4169 | **265** |
| **270** | 0.096 20 | 2938.4 | 6.5357 | 0.088 09 | 2930.7 | 6.4877 | 0.081 11 | 2922.9 | 6.4422 | **270** |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 2.4 MPa ($t_{sat}$ = 221.80 °C) | | | 2.6 MPa ($t_{sat}$ = 226.05 °C) | | | 2.8 MPa ($t_{sat}$ = 230.06 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 0.097 43 | 2951.1 | 6.5590 | 0.089 24 | 2943.8 | 6.5117 | 0.082 22 | 2936.3 | 6.4668 | 275 |
| 280 | 0.098 64 | 2963.6 | 6.5818 | 0.090 39 | 2956.6 | 6.5350 | 0.083 31 | 2949.5 | 6.4907 | 280 |
| 285 | 0.099 84 | 2976.1 | 6.6042 | 0.091 52 | 2969.3 | 6.5579 | 0.084 38 | 2962.5 | 6.5141 | 285 |
| 290 | 0.101 02 | 2988.4 | 6.6261 | 0.092 64 | 2981.9 | 6.5803 | 0.085 44 | 2975.3 | 6.5370 | 290 |
| 295 | 0.102 20 | 3000.5 | 6.6476 | 0.093 74 | 2994.3 | 6.6023 | 0.086 49 | 2988.0 | 6.5594 | 295 |
| 300 | 0.103 36 | 3012.6 | 6.6688 | 0.094 84 | 3006.6 | 6.6238 | 0.087 52 | 3000.5 | 6.5814 | 300 |
| 310 | 0.105 67 | 3036.5 | 6.7101 | 0.097 00 | 3030.9 | 6.6658 | 0.089 57 | 3025.2 | 6.6242 | 310 |
| 320 | 0.107 94 | 3060.0 | 6.7501 | 0.099 13 | 3054.8 | 6.7064 | 0.091 57 | 3049.5 | 6.6654 | 320 |
| 330 | 0.110 18 | 3083.2 | 6.7890 | 0.101 23 | 3078.4 | 6.7459 | 0.093 55 | 3073.5 | 6.7054 | 330 |
| 340 | 0.112 39 | 3106.3 | 6.8268 | 0.103 30 | 3101.7 | 6.7842 | 0.095 50 | 3097.1 | 6.7443 | 340 |
| 350 | 0.114 59 | 3129.1 | 6.8638 | 0.105 35 | 3124.8 | 6.8216 | 0.097 42 | 3120.5 | 6.7821 | 350 |
| 360 | 0.116 76 | 3151.8 | 6.9000 | 0.107 38 | 3147.8 | 6.8582 | 0.099 33 | 3143.6 | 6.8190 | 360 |
| 370 | 0.118 92 | 3174.4 | 6.9353 | 0.109 39 | 3170.6 | 6.8939 | 0.101 22 | 3166.7 | 6.8551 | 370 |
| 380 | 0.121 06 | 3196.9 | 6.9700 | 0.111 38 | 3193.2 | 6.9289 | 0.103 09 | 3189.5 | 6.8904 | 380 |
| 390 | 0.123 18 | 3219.3 | 7.0041 | 0.113 36 | 3215.8 | 6.9632 | 0.104 94 | 3212.3 | 6.9250 | 390 |
| 400 | 0.125 30 | 3241.6 | 7.0375 | 0.115 33 | 3238.3 | 6.9968 | 0.106 78 | 3234.9 | 6.9589 | 400 |
| 410 | 0.127 40 | 3263.9 | 7.0703 | 0.117 29 | 3260.7 | 7.0299 | 0.108 61 | 3257.5 | 6.9922 | 410 |
| 420 | 0.129 49 | 3286.1 | 7.1026 | 0.119 23 | 3283.1 | 7.0624 | 0.110 43 | 3280.0 | 7.0249 | 420 |
| 430 | 0.131 57 | 3308.4 | 7.1345 | 0.121 17 | 3305.4 | 7.0944 | 0.112 24 | 3302.5 | 7.0571 | 430 |
| 440 | 0.133 65 | 3330.5 | 7.1658 | 0.123 09 | 3327.8 | 7.1259 | 0.114 04 | 3325.0 | 7.0888 | 440 |
| 450 | 0.135 71 | 3352.7 | 7.1967 | 0.125 01 | 3350.0 | 7.1570 | 0.115 84 | 3347.4 | 7.1200 | 450 |
| 460 | 0.137 77 | 3374.9 | 7.2271 | 0.126 92 | 3372.3 | 7.1876 | 0.117 62 | 3369.7 | 7.1507 | 460 |
| 470 | 0.139 82 | 3397.1 | 7.2572 | 0.128 82 | 3394.6 | 7.2177 | 0.119 40 | 3392.1 | 7.1810 | 470 |
| 480 | 0.141 87 | 3419.3 | 7.2868 | 0.130 72 | 3416.9 | 7.2475 | 0.121 17 | 3414.5 | 7.2109 | 480 |
| 490 | 0.143 91 | 3441.5 | 7.3161 | 0.132 61 | 3439.2 | 7.2769 | 0.122 93 | 3436.9 | 7.2405 | 490 |
| 500 | 0.145 94 | 3463.7 | 7.3450 | 0.134 50 | 3461.5 | 7.3060 | 0.124 69 | 3459.3 | 7.2696 | 500 |
| 510 | 0.147 97 | 3485.9 | 7.3736 | 0.136 38 | 3483.8 | 7.3346 | 0.126 45 | 3481.7 | 7.2984 | 510 |
| 520 | 0.149 99 | 3508.2 | 7.4019 | 0.138 25 | 3506.1 | 7.3630 | 0.128 19 | 3504.1 | 7.3268 | 520 |
| 530 | 0.152 01 | 3530.5 | 7.4298 | 0.140 12 | 3528.5 | 7.3910 | 0.129 94 | 3526.5 | 7.3549 | 530 |
| 540 | 0.154 02 | 3552.8 | 7.4574 | 0.141 99 | 3550.9 | 7.4187 | 0.131 68 | 3549.0 | 7.3827 | 540 |
| 550 | 0.156 03 | 3575.2 | 7.4848 | 0.143 85 | 3573.3 | 7.4461 | 0.133 41 | 3571.5 | 7.4102 | 550 |
| 560 | 0.158 04 | 3597.6 | 7.5118 | 0.145 71 | 3595.8 | 7.4732 | 0.135 15 | 3594.0 | 7.4374 | 560 |
| 570 | 0.160 04 | 3620.0 | 7.5386 | 0.147 57 | 3618.3 | 7.5001 | 0.136 88 | 3616.5 | 7.4643 | 570 |
| 580 | 0.162 04 | 3642.5 | 7.5651 | 0.149 42 | 3640.8 | 7.5266 | 0.138 60 | 3639.1 | 7.4909 | 580 |
| 590 | 0.164 04 | 3665.0 | 7.5913 | 0.151 27 | 3663.4 | 7.5529 | 0.140 32 | 3661.7 | 7.5173 | 590 |
| 600 | 0.166 03 | 3687.6 | 7.6173 | 0.153 11 | 3686.0 | 7.5790 | 0.142 04 | 3684.4 | 7.5434 | 600 |
| 610 | 0.168 02 | 3710.2 | 7.6430 | 0.154 96 | 3708.6 | 7.6048 | 0.143 76 | 3707.1 | 7.5692 | 610 |
| 620 | 0.170 01 | 3732.8 | 7.6686 | 0.156 80 | 3731.3 | 7.6303 | 0.145 47 | 3729.8 | 7.5949 | 620 |
| 630 | 0.171 99 | 3755.5 | 7.6938 | 0.158 63 | 3754.1 | 7.6557 | 0.147 18 | 3752.6 | 7.6202 | 630 |
| 640 | 0.173 98 | 3778.3 | 7.7189 | 0.160 47 | 3776.9 | 7.6808 | 0.148 89 | 3775.5 | 7.6454 | 640 |
| 650 | 0.175 96 | 3801.1 | 7.7437 | 0.162 30 | 3799.7 | 7.7056 | 0.150 60 | 3798.4 | 7.6703 | 650 |
| 660 | 0.177 94 | 3823.9 | 7.7683 | 0.164 13 | 3822.6 | 7.7303 | 0.152 30 | 3821.3 | 7.6950 | 660 |
| 670 | 0.179 91 | 3846.8 | 7.7928 | 0.165 96 | 3845.6 | 7.7548 | 0.154 00 | 3844.3 | 7.7195 | 670 |
| 680 | 0.181 89 | 3869.8 | 7.8170 | 0.167 79 | 3868.6 | 7.7790 | 0.155 70 | 3867.3 | 7.7438 | 680 |
| 690 | 0.183 86 | 3892.8 | 7.8410 | 0.169 61 | 3891.6 | 7.8031 | 0.157 40 | 3890.4 | 7.7679 | 690 |
| 700 | 0.185 83 | 3915.9 | 7.8648 | 0.171 44 | 3914.7 | 7.8269 | 0.159 10 | 3913.5 | 7.7918 | 700 |
| 710 | 0.187 80 | 3939.0 | 7.8885 | 0.173 26 | 3937.9 | 7.8506 | 0.160 79 | 3936.7 | 7.8155 | 710 |
| 720 | 0.189 77 | 3962.2 | 7.9119 | 0.175 08 | 3961.1 | 7.8741 | 0.162 48 | 3960.0 | 7.8390 | 720 |
| 730 | 0.191 74 | 3985.4 | 7.9352 | 0.176 90 | 3984.3 | 7.8974 | 0.164 18 | 3983.3 | 7.8624 | 730 |
| 740 | 0.193 70 | 4008.7 | 7.9583 | 0.178 71 | 4007.7 | 7.9206 | 0.165 87 | 4006.6 | 7.8855 | 740 |
| 750 | 0.195 66 | 4032.1 | 7.9813 | 0.180 53 | 4031.1 | 7.9435 | 0.167 56 | 4030.0 | 7.9085 | 750 |
| 760 | 0.197 63 | 4055.5 | 8.0040 | 0.182 34 | 4054.5 | 7.9663 | 0.169 24 | 4053.5 | 7.9314 | 760 |
| 770 | 0.199 59 | 4079.0 | 8.0267 | 0.184 16 | 4078.0 | 7.9890 | 0.170 93 | 4077.0 | 7.9540 | 770 |
| 780 | 0.201 55 | 4102.5 | 8.0491 | 0.185 97 | 4101.6 | 8.0114 | 0.172 61 | 4100.6 | 7.9765 | 780 |
| 790 | 0.203 51 | 4126.1 | 8.0714 | 0.187 78 | 4125.2 | 8.0338 | 0.174 30 | 4124.2 | 7.9989 | 790 |
| 800 | 0.205 47 | 4149.8 | 8.0936 | 0.189 59 | 4148.9 | 8.0559 | 0.175 99 | 4148.0 | 8.0210 | 800 |

**UNITS**: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 3.0 MPa ($t_{sat}$ = 233.86 °C) | | | 3.4 MPa ($t_{sat}$ = 240.90 °C) | | | 3.8 MPa ($t_{sat}$ = 247.33 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| Sat. Liq. | 0.001 217 | 1008.4 | 2.6456 | 0.001 231 | 1041.8 | 2.7102 | 0.001 246 | 1072.8 | 2.7690 | Sat. Liq. |
| Sat. Vap. | 0.066 66 | 2803.3 | 6.1858 | 0.058 76 | 2803.0 | 6.1362 | 0.052 47 | 2801.8 | 6.0910 | Sat. Vap. |
| **0** | 0.000 998 7 | 3.01 | 0.0000 | 0.000 998 5 | 3.41 | 0.0001 | 0.000 998 3 | 3.82 | 0.0001 | **0** |
| **5** | 0.000 998 6 | 24.00 | 0.0762 | 0.000 998 4 | 24.40 | 0.0762 | 0.000 998 2 | 24.79 | 0.0762 | **5** |
| **10** | 0.000 998 9 | 44.94 | 0.1508 | 0.000 998 7 | 45.33 | 0.1508 | 0.000 998 5 | 45.72 | 0.1507 | **10** |
| **15** | 0.000 999 6 | 65.85 | 0.2240 | 0.000 999 4 | 66.23 | 0.2239 | 0.000 999 2 | 66.61 | 0.2239 | **15** |
| **20** | 0.001 000 5 | 86.74 | 0.2959 | 0.001 000 3 | 87.11 | 0.2958 | 0.001 000 1 | 87.49 | 0.2957 | **20** |
| **25** | 0.001 001 7 | 107.61 | 0.3665 | 0.001 001 5 | 107.98 | 0.3664 | 0.001 001 3 | 108.35 | 0.3663 | **25** |
| **30** | 0.001 003 1 | 128.47 | 0.4359 | 0.001 002 9 | 128.84 | 0.4358 | 0.001 002 7 | 129.20 | 0.4356 | **30** |
| **35** | 0.001 004 7 | 149.33 | 0.5041 | 0.001 004 5 | 149.69 | 0.5040 | 0.001 004 4 | 150.05 | 0.5038 | **35** |
| **40** | 0.001 006 6 | 170.19 | 0.5713 | 0.001 006 4 | 170.55 | 0.5711 | 0.001 006 2 | 170.90 | 0.5710 | **40** |
| **45** | 0.001 008 6 | 191.05 | 0.6373 | 0.001 008 4 | 191.40 | 0.6372 | 0.001 008 2 | 191.75 | 0.6370 | **45** |
| **50** | 0.001 010 8 | 211.91 | 0.7024 | 0.001 010 6 | 212.26 | 0.7022 | 0.001 010 5 | 212.60 | 0.7020 | **50** |
| **55** | 0.001 013 2 | 232.78 | 0.7665 | 0.001 013 0 | 233.12 | 0.7663 | 0.001 012 9 | 233.46 | 0.7661 | **55** |
| **60** | 0.001 015 8 | 253.66 | 0.8296 | 0.001 015 6 | 253.99 | 0.8294 | 0.001 015 4 | 254.33 | 0.8292 | **60** |
| **65** | 0.001 018 5 | 274.54 | 0.8919 | 0.001 018 3 | 274.88 | 0.8916 | 0.001 018 1 | 275.21 | 0.8914 | **65** |
| **70** | 0.001 021 4 | 295.45 | 0.9532 | 0.001 021 2 | 295.77 | 0.9530 | 0.001 021 0 | 296.10 | 0.9527 | **70** |
| **75** | 0.001 024 4 | 316.36 | 1.0137 | 0.001 024 3 | 316.69 | 1.0135 | 0.001 024 1 | 317.01 | 1.0132 | **75** |
| **80** | 0.001 027 6 | 337.30 | 1.0734 | 0.001 027 5 | 337.62 | 1.0732 | 0.001 027 3 | 337.94 | 1.0729 | **80** |
| **85** | 0.001 031 0 | 358.26 | 1.1324 | 0.001 030 8 | 358.57 | 1.1321 | 0.001 030 6 | 358.88 | 1.1318 | **85** |
| **90** | 0.001 034 5 | 379.24 | 1.1905 | 0.001 034 3 | 379.55 | 1.1903 | 0.001 034 1 | 379.86 | 1.1900 | **90** |
| **95** | 0.001 038 2 | 400.24 | 1.2480 | 0.001 038 0 | 400.55 | 1.2477 | 0.001 037 8 | 400.85 | 1.2474 | **95** |
| **100** | 0.001 042 0 | 421.28 | 1.3048 | 0.001 041 8 | 421.58 | 1.3044 | 0.001 041 6 | 421.88 | 1.3041 | **100** |
| **105** | 0.001 045 9 | 442.34 | 1.3608 | 0.001 045 7 | 442.64 | 1.3605 | 0.001 045 5 | 442.94 | 1.3602 | **105** |
| **110** | 0.001 050 1 | 463.44 | 1.4163 | 0.001 049 9 | 463.73 | 1.4159 | 0.001 049 6 | 464.03 | 1.4156 | **110** |
| **115** | 0.001 054 3 | 484.58 | 1.4711 | 0.001 054 1 | 484.87 | 1.4707 | 0.001 053 9 | 485.15 | 1.4704 | **115** |
| **120** | 0.001 058 8 | 505.76 | 1.5253 | 0.001 058 5 | 506.04 | 1.5249 | 0.001 058 3 | 506.32 | 1.5246 | **120** |
| **125** | 0.001 063 3 | 526.97 | 1.5789 | 0.001 063 1 | 527.25 | 1.5785 | 0.001 062 9 | 527.53 | 1.5782 | **125** |
| **130** | 0.001 068 1 | 548.24 | 1.6320 | 0.001 067 9 | 548.51 | 1.6316 | 0.001 067 6 | 548.78 | 1.6312 | **130** |
| **135** | 0.001 073 0 | 569.55 | 1.6845 | 0.001 072 8 | 569.81 | 1.6841 | 0.001 072 5 | 570.08 | 1.6837 | **135** |
| **140** | 0.001 078 1 | 590.91 | 1.7365 | 0.001 077 9 | 591.17 | 1.7361 | 0.001 077 6 | 591.43 | 1.7357 | **140** |
| **145** | 0.001 083 4 | 612.33 | 1.7881 | 0.001 083 1 | 612.59 | 1.7877 | 0.001 082 8 | 612.84 | 1.7872 | **145** |
| **150** | 0.001 088 8 | 633.81 | 1.8391 | 0.001 088 5 | 634.06 | 1.8387 | 0.001 088 3 | 634.31 | 1.8383 | **150** |
| **155** | 0.001 094 4 | 655.36 | 1.8898 | 0.001 094 2 | 655.60 | 1.8893 | 0.001 093 9 | 655.84 | 1.8888 | **155** |
| **160** | 0.001 100 3 | 676.97 | 1.9399 | 0.001 100 0 | 677.20 | 1.9395 | 0.001 099 7 | 677.44 | 1.9390 | **160** |
| **165** | 0.001 106 3 | 698.65 | 1.9897 | 0.001 106 0 | 698.88 | 1.9892 | 0.001 105 7 | 699.11 | 1.9887 | **165** |
| **170** | 0.001 112 5 | 720.42 | 2.0391 | 0.001 112 2 | 720.64 | 2.0386 | 0.001 111 9 | 720.86 | 2.0381 | **170** |
| **175** | 0.001 119 0 | 742.26 | 2.0881 | 0.001 118 7 | 742.47 | 2.0876 | 0.001 118 4 | 742.69 | 2.0871 | **175** |
| **180** | 0.001 125 7 | 764.20 | 2.1368 | 0.001 125 4 | 764.40 | 2.1363 | 0.001 125 0 | 764.61 | 2.1357 | **180** |
| **185** | 0.001 132 6 | 786.23 | 2.1852 | 0.001 132 3 | 786.42 | 2.1846 | 0.001 131 9 | 786.62 | 2.1840 | **185** |
| **190** | 0.001 139 8 | 808.37 | 2.2332 | 0.001 139 5 | 808.55 | 2.2326 | 0.001 139 1 | 808.74 | 2.2320 | **190** |
| **195** | 0.001 147 3 | 830.61 | 2.2810 | 0.001 146 9 | 830.79 | 2.2804 | 0.001 146 5 | 830.96 | 2.2798 | **195** |
| **200** | 0.001 155 0 | 852.98 | 2.3285 | 0.001 154 6 | 853.14 | 2.3279 | 0.001 154 2 | 853.31 | 2.3272 | **200** |
| **205** | 0.001 163 1 | 875.47 | 2.3758 | 0.001 162 7 | 875.62 | 2.3751 | 0.001 162 3 | 875.78 | 2.3745 | **205** |
| **210** | 0.001 171 5 | 898.10 | 2.4229 | 0.001 171 0 | 898.24 | 2.4222 | 0.001 170 6 | 898.38 | 2.4215 | **210** |
| **215** | 0.001 180 2 | 920.88 | 2.4698 | 0.001 179 7 | 921.01 | 2.4691 | 0.001 179 3 | 921.13 | 2.4684 | **215** |
| **220** | 0.001 189 3 | 943.83 | 2.5165 | 0.001 188 8 | 943.94 | 2.5158 | 0.001 188 3 | 944.05 | 2.5151 | **220** |
| **225** | 0.001 198 8 | 966.94 | 2.5632 | 0.001 198 3 | 967.04 | 2.5624 | 0.001 197 7 | 967.13 | 2.5616 | **225** |
| **230** | 0.001 209 | 990.25 | 2.6097 | 0.001 208 | 990.32 | 2.6089 | 0.001 208 | 990.40 | 2.6081 | **230** |
| **235** | 0.066 96 | 2807.4 | 6.1938 | 0.001 219 | 1013.8 | 2.6554 | 0.001 218 | 1013.9 | 2.6545 | **235** |
| **240** | 0.068 23 | 2824.6 | 6.2275 | 0.001 229 | 1037.5 | 2.7018 | 0.001 229 | 1037.6 | 2.7009 | **240** |
| **245** | 0.069 44 | 2840.9 | 6.2592 | 0.059 73 | 2818.0 | 6.1653 | 0.001 240 | 1061.5 | 2.7473 | **245** |
| **250** | 0.070 62 | 2856.5 | 6.2893 | 0.060 86 | 2835.3 | 6.1986 | 0.053 06 | 2812.1 | 6.1107 | **250** |
| **255** | 0.071 77 | 2871.7 | 6.3181 | 0.061 95 | 2851.9 | 6.2301 | 0.054 13 | 2830.4 | 6.1456 | **255** |
| **260** | 0.072 89 | 2886.4 | 6.3458 | 0.063 01 | 2867.8 | 6.2600 | 0.055 15 | 2847.8 | 6.1783 | **260** |
| **265** | 0.073 98 | 2900.8 | 6.3727 | 0.064 04 | 2883.2 | 6.2888 | 0.056 13 | 2864.4 | 6.2094 | **265** |
| **270** | 0.075 06 | 2914.8 | 6.3987 | 0.065 05 | 2898.1 | 6.3164 | 0.057 09 | 2880.4 | 6.2390 | **270** |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 3.0 MPa ($t_{sat}$ = 233.86 °C) | | | 3.4 MPa ($t_{sat}$ = 240.90 °C) | | | 3.8 MPa ($t_{sat}$ = 247.33 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 0.076 12 | 2928.6 | 6.4239 | 0.066 03 | 2912.7 | 6.3432 | 0.058 03 | 2896.0 | 6.2675 | 275 |
| 280 | 0.077 16 | 2942.2 | 6.4485 | 0.067 00 | 2927.0 | 6.3692 | 0.058 94 | 2911.1 | 6.2950 | 280 |
| 285 | 0.078 18 | 2955.5 | 6.4725 | 0.067 94 | 2941.0 | 6.3944 | 0.059 83 | 2925.9 | 6.3216 | 285 |
| 290 | 0.079 19 | 2968.6 | 6.4959 | 0.068 88 | 2954.8 | 6.4189 | 0.060 70 | 2940.4 | 6.3474 | 290 |
| 295 | 0.080 19 | 2981.6 | 6.5188 | 0.069 79 | 2968.3 | 6.4428 | 0.061 56 | 2954.5 | 6.3724 | 295 |
| 300 | 0.081 18 | 2994.3 | 6.5412 | 0.070 70 | 2981.6 | 6.4662 | 0.062 40 | 2968.4 | 6.3968 | 300 |
| 310 | 0.083 12 | 3019.5 | 6.5847 | 0.072 48 | 3007.8 | 6.5114 | 0.064 05 | 2995.6 | 6.4438 | 310 |
| 320 | 0.085 02 | 3044.2 | 6.6267 | 0.074 21 | 3033.3 | 6.5547 | 0.065 66 | 3022.0 | 6.4887 | 320 |
| 330 | 0.086 89 | 3068.5 | 6.6673 | 0.075 91 | 3058.3 | 6.5966 | 0.067 23 | 3047.8 | 6.5319 | 330 |
| 340 | 0.088 74 | 3092.4 | 6.7066 | 0.077 59 | 3082.9 | 6.6370 | 0.068 77 | 3073.1 | 6.5734 | 340 |
| 350 | 0.090 56 | 3116.1 | 6.7449 | 0.079 23 | 3107.1 | 6.6762 | 0.070 28 | 3098.0 | 6.6137 | 350 |
| 360 | 0.092 35 | 3139.5 | 6.7822 | 0.080 86 | 3131.1 | 6.7143 | 0.071 77 | 3122.5 | 6.6527 | 360 |
| 370 | 0.094 13 | 3162.7 | 6.8186 | 0.082 46 | 3154.8 | 6.7515 | 0.073 24 | 3146.7 | 6.6906 | 370 |
| 380 | 0.095 90 | 3185.8 | 6.8542 | 0.084 05 | 3178.3 | 6.7877 | 0.074 68 | 3170.6 | 6.7275 | 380 |
| 390 | 0.097 64 | 3208.7 | 6.8891 | 0.085 62 | 3201.6 | 6.8232 | 0.076 11 | 3194.3 | 6.7635 | 390 |
| 400 | 0.099 38 | 3231.6 | 6.9233 | 0.087 17 | 3224.8 | 6.8579 | 0.077 53 | 3217.9 | 6.7988 | 400 |
| 410 | 0.101 10 | 3254.3 | 6.9568 | 0.088 72 | 3247.8 | 6.8919 | 0.078 93 | 3241.3 | 6.8333 | 410 |
| 420 | 0.102 81 | 3277.0 | 6.9897 | 0.090 25 | 3270.8 | 6.9252 | 0.080 33 | 3264.5 | 6.8671 | 420 |
| 430 | 0.104 51 | 3299.6 | 7.0221 | 0.091 77 | 3293.7 | 6.9580 | 0.081 71 | 3287.7 | 6.9003 | 430 |
| 440 | 0.106 20 | 3322.1 | 7.0540 | 0.093 28 | 3316.5 | 6.9902 | 0.083 08 | 3310.7 | 6.9328 | 440 |
| 450 | 0.107 88 | 3344.7 | 7.0853 | 0.094 78 | 3339.2 | 7.0219 | 0.084 44 | 3333.7 | 6.9649 | 450 |
| 460 | 0.109 56 | 3367.2 | 7.1162 | 0.096 28 | 3361.9 | 7.0531 | 0.085 79 | 3356.7 | 6.9964 | 460 |
| 470 | 0.111 23 | 3389.6 | 7.1467 | 0.097 77 | 3384.6 | 7.0838 | 0.087 14 | 3379.6 | 7.0274 | 470 |
| 480 | 0.112 89 | 3412.1 | 7.1767 | 0.099 25 | 3407.3 | 7.1141 | 0.088 48 | 3402.4 | 7.0580 | 480 |
| 490 | 0.114 54 | 3434.6 | 7.2063 | 0.100 72 | 3429.9 | 7.1440 | 0.089 81 | 3425.3 | 7.0881 | 490 |
| 500 | 0.116 19 | 3457.0 | 7.2356 | 0.102 19 | 3452.6 | 7.1735 | 0.091 14 | 3448.1 | 7.1178 | 500 |
| 510 | 0.117 84 | 3479.5 | 7.2645 | 0.103 66 | 3475.2 | 7.2026 | 0.092 46 | 3470.9 | 7.1471 | 510 |
| 520 | 0.119 48 | 3502.0 | 7.2930 | 0.105 12 | 3497.9 | 7.2313 | 0.093 78 | 3493.7 | 7.1760 | 520 |
| 530 | 0.121 11 | 3524.5 | 7.3212 | 0.106 57 | 3520.5 | 7.2597 | 0.095 09 | 3516.5 | 7.2046 | 530 |
| 540 | 0.122 74 | 3547.0 | 7.3491 | 0.108 02 | 3543.2 | 7.2877 | 0.096 40 | 3539.3 | 7.2328 | 540 |
| 550 | 0.124 37 | 3569.6 | 7.3767 | 0.109 47 | 3565.9 | 7.3154 | 0.097 70 | 3562.1 | 7.2607 | 550 |
| 560 | 0.125 99 | 3592.2 | 7.4039 | 0.110 91 | 3588.6 | 7.3429 | 0.099 00 | 3584.9 | 7.2882 | 560 |
| 570 | 0.127 61 | 3614.8 | 7.4309 | 0.112 35 | 3611.3 | 7.3700 | 0.100 29 | 3607.8 | 7.3155 | 570 |
| 580 | 0.129 22 | 3637.4 | 7.4576 | 0.113 78 | 3634.0 | 7.3968 | 0.101 59 | 3630.6 | 7.3424 | 580 |
| 590 | 0.130 84 | 3660.1 | 7.4840 | 0.115 21 | 3656.8 | 7.4233 | 0.102 88 | 3653.5 | 7.3691 | 590 |
| 600 | 0.132 44 | 3682.8 | 7.5102 | 0.116 64 | 3679.6 | 7.4496 | 0.104 16 | 3676.4 | 7.3955 | 600 |
| 610 | 0.134 05 | 3705.6 | 7.5361 | 0.118 07 | 3702.5 | 7.4756 | 0.105 44 | 3699.4 | 7.4216 | 610 |
| 620 | 0.135 65 | 3728.4 | 7.5617 | 0.119 49 | 3725.4 | 7.5014 | 0.106 72 | 3722.4 | 7.4475 | 620 |
| 630 | 0.137 26 | 3751.2 | 7.5872 | 0.120 91 | 3748.3 | 7.5269 | 0.108 00 | 3745.4 | 7.4731 | 630 |
| 640 | 0.138 85 | 3774.1 | 7.6124 | 0.122 33 | 3771.3 | 7.5522 | 0.109 28 | 3768.4 | 7.4985 | 640 |
| 650 | 0.140 45 | 3797.0 | 7.6373 | 0.123 74 | 3794.3 | 7.5773 | 0.110 55 | 3791.5 | 7.5237 | 650 |
| 660 | 0.142 05 | 3820.0 | 7.6621 | 0.125 15 | 3817.3 | 7.6021 | 0.111 82 | 3814.7 | 7.5486 | 660 |
| 670 | 0.143 64 | 3843.0 | 7.6866 | 0.126 57 | 3840.4 | 7.6267 | 0.113 09 | 3837.8 | 7.5733 | 670 |
| 680 | 0.145 23 | 3866.1 | 7.7109 | 0.127 98 | 3863.5 | 7.6511 | 0.114 36 | 3861.0 | 7.5978 | 680 |
| 690 | 0.146 82 | 3889.2 | 7.7351 | 0.129 38 | 3886.7 | 7.6753 | 0.115 62 | 3884.3 | 7.6220 | 690 |
| 700 | 0.148 40 | 3912.3 | 7.7590 | 0.130 79 | 3910.0 | 7.6993 | 0.116 88 | 3907.6 | 7.6461 | 700 |
| 710 | 0.149 99 | 3935.6 | 7.7828 | 0.132 19 | 3933.3 | 7.7232 | 0.118 14 | 3930.9 | 7.6700 | 710 |
| 720 | 0.151 57 | 3958.8 | 7.8063 | 0.133 60 | 3956.6 | 7.7468 | 0.119 40 | 3954.3 | 7.6937 | 720 |
| 730 | 0.153 15 | 3982.2 | 7.8297 | 0.135 00 | 3980.0 | 7.7702 | 0.120 66 | 3977.8 | 7.7172 | 730 |
| 740 | 0.154 73 | 4005.6 | 7.8529 | 0.136 40 | 4003.4 | 7.7935 | 0.121 92 | 4001.3 | 7.7405 | 740 |
| 750 | 0.156 31 | 4029.0 | 7.8759 | 0.137 79 | 4026.9 | 7.8165 | 0.123 17 | 4024.8 | 7.7636 | 750 |
| 760 | 0.157 89 | 4052.5 | 7.8987 | 0.139 19 | 4050.5 | 7.8394 | 0.124 43 | 4048.4 | 7.7865 | 760 |
| 770 | 0.159 47 | 4076.0 | 7.9214 | 0.140 59 | 4074.1 | 7.8622 | 0.125 68 | 4072.1 | 7.8093 | 770 |
| 780 | 0.161 04 | 4099.6 | 7.9440 | 0.141 98 | 4097.7 | 7.8847 | 0.126 93 | 4095.8 | 7.8319 | 780 |
| 790 | 0.162 62 | 4123.3 | 7.9663 | 0.143 37 | 4121.4 | 7.9071 | 0.128 18 | 4119.6 | 7.8544 | 790 |
| 800 | 0.164 19 | 4147.0 | 7.9885 | 0.144 77 | 4145.2 | 7.9294 | 0.129 43 | 4143.4 | 7.8767 | 800 |

**UNITS**: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 4.2 MPa ($t_{sat}$ = 253.27 °C) | | | 4.6 MPa ($t_{sat}$ = 258.78 °C) | | | 5.0 MPa ($t_{sat}$ = 263.94 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 259 | 1101.6 | 2.8232 | 0.001 273 | 1128.8 | 2.8736 | 0.001 286 | 1154.5 | 2.9207 | Sat. Liq |
| Sat. Vap. | 0.047 33 | 2799.9 | 6.0492 | 0.043 06 | 2797.3 | 6.0103 | 0.039 45 | 2794.2 | 5.9737 | Sat. Vap |
| 0 | 0.000 998 1 | 4.22 | 0.0001 | 0.000 997 9 | 4.63 | 0.0001 | 0.000 997 7 | 5.03 | 0.0001 | 0 |
| 5 | 0.000 998 0 | 25.19 | 0.0762 | 0.000 997 8 | 25.58 | | 0.000 997 6 | 25.98 | 0.0761 | 5 |
| 10 | 0.000 998 4 | 46.11 | 0.1507 | 0.000 998 2 | 46.49 | 0.1507 | 0.000 998 0 | 46.88 | 0.1506 | 10 |
| 15 | 0.000 999 0 | 66.99 | 0.2238 | 0.000 998 8 | 67.38 | 0.2238 | 0.000 998 6 | 67.76 | 0.2237 | 15 |
| 20 | 0.000 999 9 | 87.86 | 0.2956 | 0.000 999 7 | 88.24 | 0.2955 | 0.000 999 6 | 88.61 | 0.2955 | 20 |
| 25 | 0.001 001 1 | 108.72 | 0.3662 | 0.001 000 9 | 109.09 | 0.3661 | 0.001 000 8 | 109.46 | 0.3660 | 25 |
| 30 | 0.001 002 5 | 129.57 | 0.4355 | 0.001 002 4 | 129.93 | 0.4354 | 0.001 002 2 | 130.29 | 0.4353 | 30 |
| 35 | 0.001 004 2 | 150.41 | 0.5037 | 0.001 004 0 | 150.77 | 0.5036 | 0.001 003 8 | 151.13 | 0.5034 | 35 |
| 40 | 0.001 006 0 | 171.25 | 0.5708 | 0.001 005 9 | 171.61 | 0.5706 | 0.001 005 7 | 171.96 | 0.5705 | 40 |
| 45 | 0.001 008 1 | 192.10 | 0.6368 | 0.001 007 9 | 192.45 | 0.6367 | 0.001 007 7 | 192.80 | 0.6365 | 45 |
| 50 | 0.001 010 3 | 212.95 | 0.7019 | 0.001 010 1 | 213.29 | 0.7017 | 0.001 009 9 | 213.63 | 0.7015 | 50 |
| 55 | 0.001 012 7 | 233.80 | 0.7659 | 0.001 012 5 | 234.14 | 0.7657 | 0.001 012 3 | 234.48 | 0.7655 | 55 |
| 60 | 0.001 015 2 | 254.66 | 0.8290 | 0.001 015 1 | 255.00 | 0.8288 | 0.001 014 9 | 255.33 | 0.8286 | 60 |
| 65 | 0.001 018 0 | 275.54 | 0.8912 | 0.001 017 8 | 275.87 | 0.8910 | 0.001 017 6 | 276.20 | 0.8907 | 65 |
| 70 | 0.001 020 9 | 296.43 | 0.9525 | 0.001 020 7 | 296.75 | 0.9523 | 0.001 020 5 | 297.08 | 0.9520 | 70 |
| 75 | 0.001 023 9 | 317.33 | 1.0130 | 0.001 023 7 | 317.65 | 1.0127 | 0.001 023 5 | 317.98 | 1.0125 | 75 |
| 80 | 0.001 027 1 | 338.25 | 1.0727 | 0.001 026 9 | 338.57 | 1.0724 | 0.001 026 7 | 338.89 | 1.0721 | 80 |
| 85 | 0.001 030 4 | 359.20 | 1.1316 | 0.001 030 2 | 359.51 | 1.1313 | 0.001 030 1 | 359.83 | 1.1310 | 85 |
| 90 | 0.001 033 9 | 380.17 | 1.1897 | 0.001 033 7 | 380.48 | 1.1894 | 0.001 033 5 | 380.78 | 1.1891 | 90 |
| 95 | 0.001 037 6 | 401.16 | 1.2471 | 0.001 037 4 | 401.46 | 1.2468 | 0.001 037 2 | 401.77 | 1.2465 | 95 |
| 100 | 0.001 041 4 | 422.18 | 1.3038 | 0.001 041 2 | 422.48 | 1.3035 | 0.001 041 0 | 422.78 | 1.3032 | 100 |
| 105 | 0.001 045 3 | 443.23 | 1.3599 | 0.001 045 1 | 443.53 | 1.3595 | 0.001 044 9 | 443.83 | 1.3592 | 105 |
| 110 | 0.001 049 4 | 464.32 | 1.4153 | 0.001 049 2 | 464.61 | 1.4149 | 0.001 049 0 | 464.90 | 1.4146 | 110 |
| 115 | 0.001 053 7 | 485.44 | 1.4700 | 0.001 053 5 | 485.73 | 1.4697 | 0.001 053 3 | 486.01 | 1.4693 | 115 |
| 120 | 0.001 058 1 | 506.60 | 1.5242 | 0.001 057 9 | 506.88 | 1.5238 | 0.001 057 7 | 507.17 | 1.5235 | 120 |
| 125 | 0.001 062 7 | 527.80 | 1.5778 | 0.001 062 4 | 528.08 | 1.5774 | 0.001 062 2 | 528.36 | 1.5770 | 125 |
| 130 | 0.001 067 4 | 549.05 | 1.6308 | 0.001 067 2 | 549.32 | 1.6304 | 0.001 066 9 | 549.60 | 1.6301 | 130 |
| 135 | 0.001 072 3 | 570.35 | 1.6833 | 0.001 072 0 | 570.61 | 1.6829 | 0.001 071 8 | 570.88 | 1.6825 | 135 |
| 140 | 0.001 077 4 | 591.69 | 1.7353 | 0.001 077 1 | 591.96 | 1.7349 | 0.001 076 9 | 592.22 | 1.7345 | 140 |
| 145 | 0.001 082 6 | 613.10 | 1.7868 | 0.001 082 3 | 613.35 | 1.7864 | 0.001 082 1 | 613.61 | 1.7859 | 145 |
| 150 | 0.001 088 0 | 634.56 | 1.8378 | 0.001 087 7 | 634.81 | 1.8374 | 0.001 087 5 | 635.06 | 1.8369 | 150 |
| 155 | 0.001 093 6 | 656.08 | 1.8884 | 0.001 093 3 | 656.32 | 1.8879 | 0.001 093 1 | 656.57 | 1.8875 | 155 |
| 160 | 0.001 099 4 | 677.67 | 1.9385 | 0.001 099 1 | 677.91 | 1.9380 | 0.001 098 8 | 678.14 | 1.9376 | 160 |
| 165 | 0.001 105 4 | 699.34 | 1.9882 | 0.001 105 1 | 699.56 | 1.9878 | 0.001 104 8 | 699.79 | 1.9873 | 165 |
| 170 | 0.001 111 6 | 721.08 | 2.0376 | 0.001 111 3 | 721.30 | 2.0371 | 0.001 111 0 | 721.52 | 2.0366 | 170 |
| 175 | 0.001 118 0 | 742.90 | 2.0866 | 0.001 117 7 | 743.11 | 2.0860 | 0.001 117 4 | 743.33 | 2.0855 | 175 |
| 180 | 0.001 124 7 | 764.81 | 2.1352 | 0.001 124 4 | 765.01 | 2.1346 | 0.001 124 0 | 765.22 | 2.1341 | 180 |
| 185 | 0.001 131 6 | 786.82 | 2.1835 | 0.001 131 2 | 787.01 | 2.1829 | 0.001 130 9 | 787.21 | 2.1823 | 185 |
| 190 | 0.001 138 7 | 808.92 | 2.2315 | 0.001 138 4 | 809.11 | 2.2309 | 0.001 138 0 | 809.29 | 2.2303 | 190 |
| 195 | 0.001 146 1 | 831.14 | 2.2792 | 0.001 145 8 | 831.31 | 2.2786 | 0.001 145 4 | 831.49 | 2.2780 | 195 |
| 200 | 0.001 153 8 | 853.47 | 2.3266 | 0.001 153 4 | 853.63 | 2.3260 | 0.001 153 0 | 853.80 | 2.3254 | 200 |
| 205 | 0.001 161 8 | 875.93 | 2.3738 | 0.001 161 4 | 876.08 | 2.3732 | 0.001 161 0 | 876.24 | 2.3725 | 205 |
| 210 | 0.001 170 1 | 898.52 | 2.4208 | 0.001 169 7 | 898.66 | 2.4202 | 0.001 169 3 | 898.80 | 2.4195 | 210 |
| 215 | 0.001 178 8 | 921.26 | 2.4677 | 0.001 178 3 | 921.39 | 2.4670 | 0.001 177 9 | 921.52 | 2.4663 | 215 |
| 220 | 0.001 187 8 | 944.16 | 2.5143 | 0.001 187 3 | 944.27 | 2.5136 | 0.001 186 8 | 944.38 | 2.5129 | 220 |
| 225 | 0.001 197 2 | 967.23 | 2.5609 | 0.001 196 7 | 967.32 | 2.5601 | 0.001 196 2 | 967.42 | 2.5593 | 225 |
| 230 | 0.001 207 | 990.48 | 2.6073 | 0.001 206 | 990.56 | 2.6065 | 0.001 206 | 990.64 | 2.6057 | 230 |
| 235 | 0.001 217 | 1013.9 | 2.6537 | 0.001 217 | 1014.0 | 2.6529 | 0.001 216 | 1014.1 | 2.6520 | 235 |
| 240 | 0.001 228 | 1037.6 | 2.7000 | 0.001 227 | 1037.6 | 2.6992 | 0.001 227 | 1037.7 | 2.6983 | 240 |
| 245 | 0.001 239 | 1061.5 | 2.7464 | 0.001 239 | 1061.5 | 2.7455 | 0.001 238 | 1061.5 | 2.7446 | 245 |
| 250 | 0.001 251 | 1085.7 | 2.7928 | 0.001 251 | 1085.7 | 2.7919 | 0.001 250 | 1085.7 | 2.7909 | 250 |
| 255 | 0.047 70 | 2806.9 | 6.0625 | 0.001 263 | 1110.1 | 2.8383 | 0.001 262 | 1110.1 | 2.8373 | 255 |
| 260 | 0.048 71 | 2826.1 | 6.0989 | 0.043 30 | 2802.5 | 6.0200 | 0.001 275 | 1134.8 | 2.8839 | 260 |
| 265 | 0.049 67 | 2844.3 | 6.1328 | 0.044 27 | 2822.6 | 6.0576 | 0.039 65 | 2798.9 | 5.9823 | 265 |
| 270 | 0.050 60 | 2861.7 | 6.1649 | 0.045 18 | 2841.5 | 6.0926 | 0.040 57 | 2819.8 | 6.0211 | 270 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 4.2 MPa ($t_{sat}$ = 253.27 °C) | | | 4.6 MPa ($t_{sat}$ = 258.78 °C) | | | 5.0 MPa ($t_{sat}$ = 263.94 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| 275 | 0.051 50 | 2878.3 | 6.1954 | 0.046 06 | 2859.5 | 6.1256 | 0.041 44 | 2839.5 | 6.0571 | 275 |
| 280 | 0.052 37 | 2894.4 | 6.2246 | 0.046 91 | 2876.8 | 6.1569 | 0.042 27 | 2858.1 | 6.0909 | 280 |
| 285 | 0.053 22 | 2910.1 | 6.2528 | 0.047 73 | 2893.4 | 6.1869 | 0.043 08 | 2875.9 | 6.1229 | 285 |
| 290 | 0.054 05 | 2925.3 | 6.2800 | 0.048 53 | 2909.5 | 6.2156 | 0.043 86 | 2893.0 | 6.1535 | 290 |
| 295 | 0.054 87 | 2940.2 | 6.3063 | 0.049 31 | 2925.2 | 6.2433 | 0.044 61 | 2909.6 | 6.1828 | 295 |
| 300 | 0.055 66 | 2954.7 | 6.3318 | 0.050 07 | 2940.5 | 6.2701 | 0.045 35 | 2925.6 | 6.2109 | 300 |
| 310 | 0.057 22 | 2983.0 | 6.3808 | 0.051 55 | 2970.0 | 6.3212 | 0.046 77 | 2956.6 | 6.2645 | 310 |
| 320 | 0.058 72 | 3010.4 | 6.4273 | 0.052 97 | 2998.5 | 6.3696 | 0.048 13 | 2986.2 | 6.3148 | 320 |
| 330 | 0.060 19 | 3037.1 | 6.4719 | 0.054 36 | 3026.1 | 6.4157 | 0.049 45 | 3014.7 | 6.3625 | 330 |
| 340 | 0.061 62 | 3063.1 | 6.5147 | 0.055 71 | 3052.9 | 6.4598 | 0.050 73 | 3042.4 | 6.4080 | 340 |
| 350 | 0.063 03 | 3088.6 | 6.5560 | 0.057 02 | 3079.1 | 6.5021 | 0.051 97 | 3069.3 | 6.4515 | 350 |
| 360 | 0.064 40 | 3113.7 | 6.5959 | 0.058 31 | 3104.7 | 6.5430 | 0.053 19 | 3095.6 | 6.4934 | 360 |
| 370 | 0.065 76 | 3138.4 | 6.6346 | 0.059 58 | 3130.0 | 6.5826 | 0.054 38 | 3121.4 | 6.5339 | 370 |
| 380 | 0.067 10 | 3162.8 | 6.6722 | 0.060 83 | 3154.9 | 6.6210 | 0.055 55 | 3146.8 | 6.5731 | 380 |
| 390 | 0.068 42 | 3186.9 | 6.7089 | 0.062 05 | 3179.5 | 6.6583 | 0.056 70 | 3171.9 | 6.6111 | 390 |
| 400 | 0.069 72 | 3210.9 | 6.7447 | 0.063 27 | 3203.8 | 6.6947 | 0.057 84 | 3196.6 | 6.6481 | 400 |
| 410 | 0.071 01 | 3234.6 | 6.7797 | 0.064 46 | 3227.9 | 6.7303 | 0.058 96 | 3221.1 | 6.6842 | 410 |
| 420 | 0.072 29 | 3258.2 | 6.8140 | 0.065 65 | 3251.8 | 6.7650 | 0.060 07 | 3245.3 | 6.7194 | 420 |
| 430 | 0.073 56 | 3281.6 | 6.8476 | 0.066 82 | 3275.5 | 6.7990 | 0.061 16 | 3269.4 | 6.7539 | 430 |
| 440 | 0.074 82 | 3305.0 | 6.8805 | 0.067 99 | 3299.1 | 6.8324 | 0.062 25 | 3293.3 | 6.7877 | 440 |
| 450 | 0.076 06 | 3328.2 | 6.9129 | 0.069 14 | 3322.7 | 6.8651 | 0.063 32 | 3317.0 | 6.8208 | 450 |
| 460 | 0.077 30 | 3351.4 | 6.9447 | 0.070 29 | 3346.1 | 6.8973 | 0.064 39 | 3340.7 | 6.8532 | 460 |
| 470 | 0.078 53 | 3374.5 | 6.9761 | 0.071 42 | 3369.4 | 6.9289 | 0.065 45 | 3364.2 | 6.8851 | 470 |
| 480 | 0.079 76 | 3397.6 | 7.0069 | 0.072 55 | 3392.7 | 6.9600 | 0.066 50 | 3387.7 | 6.9165 | 480 |
| 490 | 0.080 98 | 3420.6 | 7.0372 | 0.073 68 | 3415.9 | 6.9906 | 0.067 54 | 3411.1 | 6.9474 | 490 |
| 500 | 0.082 19 | 3443.6 | 7.0672 | 0.074 80 | 3439.0 | 7.0208 | 0.068 58 | 3434.5 | 6.9778 | 500 |
| 510 | 0.083 40 | 3466.5 | 7.0967 | 0.075 91 | 3462.2 | 7.0505 | 0.069 62 | 3457.8 | 7.0078 | 510 |
| 520 | 0.084 60 | 3489.5 | 7.1258 | 0.077 01 | 3485.3 | 7.0798 | 0.070 64 | 3481.1 | 7.0373 | 520 |
| 530 | 0.085 79 | 3512.4 | 7.1546 | 0.078 12 | 3508.4 | 7.1087 | 0.071 66 | 3504.3 | 7.0664 | 530 |
| 540 | 0.086 99 | 3535.4 | 7.1830 | 0.079 21 | 3531.5 | 7.1373 | 0.072 68 | 3527.5 | 7.0952 | 540 |
| 550 | 0.088 17 | 3558.3 | 7.2110 | 0.080 30 | 3554.6 | 7.1655 | 0.073 69 | 3550.8 | 7.1235 | 550 |
| 560 | 0.089 36 | 3581.3 | 7.2387 | 0.081 39 | 3577.6 | 7.1934 | 0.074 70 | 3574.0 | 7.1516 | 560 |
| 570 | 0.090 54 | 3604.2 | 7.2661 | 0.082 48 | 3600.7 | 7.2209 | 0.075 71 | 3597.2 | 7.1793 | 570 |
| 580 | 0.091 72 | 3627.2 | 7.2932 | 0.083 56 | 3623.8 | 7.2482 | 0.076 71 | 3620.4 | 7.2066 | 580 |
| 590 | 0.092 89 | 3650.2 | 7.3200 | 0.084 64 | 3646.9 | 7.2751 | 0.077 71 | 3643.6 | 7.2337 | 590 |
| 600 | 0.094 06 | 3673.2 | 7.3465 | 0.085 71 | 3670.0 | 7.3017 | 0.078 70 | 3666.8 | 7.2604 | 600 |
| 610 | 0.095 23 | 3696.3 | 7.3728 | 0.086 79 | 3693.2 | 7.3281 | 0.079 69 | 3690.1 | 7.2869 | 610 |
| 620 | 0.096 39 | 3719.4 | 7.3987 | 0.087 85 | 3716.4 | 7.3542 | 0.080 68 | 3713.3 | 7.3131 | 620 |
| 630 | 0.097 55 | 3742.5 | 7.4245 | 0.088 92 | 3739.6 | 7.3800 | 0.081 67 | 3736.6 | 7.3390 | 630 |
| 640 | 0.098 71 | 3765.6 | 7.4499 | 0.089 99 | 3762.8 | 7.4056 | 0.082 65 | 3759.9 | 7.3647 | 640 |
| 650 | 0.099 87 | 3788.8 | 7.4752 | 0.091 05 | 3786.0 | 7.4309 | 0.083 64 | 3783.3 | 7.3901 | 650 |
| 660 | 0.101 03 | 3812.0 | 7.5002 | 0.092 11 | 3809.3 | 7.4560 | 0.084 62 | 3806.6 | 7.4153 | 660 |
| 670 | 0.102 18 | 3835.2 | 7.5250 | 0.093 16 | 3832.6 | 7.4809 | 0.085 59 | 3830.0 | 7.4402 | 670 |
| 680 | 0.103 33 | 3858.5 | 7.5495 | 0.094 22 | 3856.0 | 7.5055 | 0.086 57 | 3853.5 | 7.4650 | 680 |
| 690 | 0.104 48 | 3881.9 | 7.5739 | 0.095 27 | 3879.4 | 7.5299 | 0.087 54 | 3876.9 | 7.4894 | 690 |
| 700 | 0.105 63 | 3905.2 | 7.5980 | 0.096 33 | 3902.8 | 7.5541 | 0.088 51 | 3900.5 | 7.5137 | 700 |
| 710 | 0.106 77 | 3928.6 | 7.6220 | 0.097 38 | 3926.3 | 7.5781 | 0.089 48 | 3924.0 | 7.5378 | 710 |
| 720 | 0.107 92 | 3952.1 | 7.6457 | 0.098 43 | 3949.8 | 7.6019 | 0.090 45 | 3947.6 | 7.5617 | 720 |
| 730 | 0.109 06 | 3975.6 | 7.6692 | 0.099 47 | 3973.4 | 7.6255 | 0.091 42 | 3971.2 | 7.5853 | 730 |
| 740 | 0.110 20 | 3999.2 | 7.6926 | 0.100 52 | 3997.0 | 7.6490 | 0.092 39 | 3994.9 | 7.6088 | 740 |
| 750 | 0.111 34 | 4022.8 | 7.7158 | 0.101 56 | 4020.7 | 7.6722 | 0.093 35 | 4018.6 | 7.6321 | 750 |
| 760 | 0.112 48 | 4046.4 | 7.7388 | 0.102 61 | 4044.4 | 7.6953 | 0.094 31 | 4042.4 | 7.6552 | 760 |
| 770 | 0.113 61 | 4070.1 | 7.7616 | 0.103 65 | 4068.1 | 7.7181 | 0.095 27 | 4066.2 | 7.6781 | 770 |
| 780 | 0.114 75 | 4093.9 | 7.7843 | 0.104 69 | 4091.9 | 7.7409 | 0.096 23 | 4090.0 | 7.7009 | 780 |
| 790 | 0.115 89 | 4117.7 | 7.8068 | 0.105 73 | 4115.8 | 7.7634 | 0.097 19 | 4113.9 | 7.7235 | 790 |
| 800 | 0.117 02 | 4141.5 | 7.8291 | 0.106 77 | 4139.7 | 7.7858 | 0.098 15 | 4137.9 | 7.7459 | 800 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 5.5 MPa ($t_{sat}$ = 269.97 °C) | | | 6.0 MPa ($t_{sat}$ = 275.59 °C) | | | 6.5 MPa ($t_{sat}$ = 280.86 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 303 | 1184.9 | 2.9759 | 0.001 319 | 1213.7 | 3.0274 | 0.001 336 | 1241.2 | 3.0760 | Sat. Liq. |
| Sat. Vap. | 0.035 64 | 2789.7 | 5.9307 | 0.032 45 | 2784.6 | 5.8901 | 0.029 73 | 2778.8 | 5.8515 | Sat. Vap. |
| 0 | 0.000 997 4 | 5.54 | 0.0002 | 0.000 997 2 | 6.04 | 0.0002 | 0.000 996 9 | 6.55 | 0.0002 | 0 |
| 5 | 0.000 997 4 | 26.47 | 0.0761 | 0.000 997 2 | 26.97 | 0.0761 | 0.000 996 9 | 27.46 | 0.0761 | 5 |
| 10 | 0.000 997 7 | 47.37 | 0.1506 | 0.000 997 5 | 47.85 | 0.1505 | 0.000 997 3 | 48.34 | 0.1505 | 10 |
| 15 | 0.000 998 4 | 68.23 | 0.2236 | 0.000 998 2 | 68.71 | 0.2235 | 0.000 997 9 | 69.18 | 0.2235 | 15 |
| 20 | 0.000 999 3 | 89.08 | 0.2953 | 0.000 999 1 | 89.55 | 0.2952 | 0.000 998 9 | 90.02 | 0.2951 | 20 |
| 25 | 0.001 000 5 | 109.92 | 0.3658 | 0.001 000 3 | 110.38 | 0.3657 | 0.001 000 1 | 110.84 | 0.3656 | 25 |
| 30 | 0.001 002 0 | 130.75 | 0.4351 | 0.001 001 7 | 131.20 | 0.4350 | 0.001 001 5 | 131.66 | 0.4348 | 30 |
| 35 | 0.001 003 6 | 151.58 | 0.5033 | 0.001 003 4 | 152.02 | 0.5031 | 0.001 003 2 | 152.47 | 0.5029 | 35 |
| 40 | 0.001 005 5 | 172.40 | 0.5703 | 0.001 005 2 | 172.84 | 0.5701 | 0.001 005 0 | 173.29 | 0.5699 | 40 |
| 45 | 0.001 007 5 | 193.23 | 0.6363 | 0.001 007 3 | 193.67 | 0.6361 | 0.001 007 1 | 194.10 | 0.6359 | 45 |
| 50 | 0.001 009 7 | 214.06 | 0.7013 | 0.001 009 5 | 214.49 | 0.7010 | 0.001 009 3 | 214.92 | 0.7008 | 50 |
| 55 | 0.001 012 1 | 234.90 | 0.7653 | 0.001 011 9 | 235.33 | 0.7650 | 0.001 011 7 | 235.75 | 0.7648 | 55 |
| 60 | 0.001 014 7 | 255.75 | 0.8283 | 0.001 014 4 | 256.17 | 0.8280 | 0.001 014 2 | 256.59 | 0.8278 | 60 |
| 65 | 0.001 017 4 | 276.61 | 0.8905 | 0.001 017 2 | 277.03 | 0.8902 | 0.001 016 9 | 277.44 | 0.8899 | 65 |
| 70 | 0.001 020 3 | 297.49 | 0.9517 | 0.001 020 0 | 297.90 | 0.9514 | 0.001 019 8 | 298.31 | 0.9512 | 70 |
| 75 | 0.001 023 3 | 318.38 | 1.0122 | 0.001 023 1 | 318.78 | 1.0119 | 0.001 022 8 | 319.19 | 1.0116 | 75 |
| 80 | 0.001 026 5 | 339.29 | 1.0718 | 0.001 026 2 | 339.69 | 1.0715 | 0.001 026 0 | 340.08 | 1.0712 | 80 |
| 85 | 0.001 029 8 | 360.22 | 1.1307 | 0.001 029 6 | 360.61 | 1.1303 | 0.001 029 3 | 361.00 | 1.1300 | 85 |
| 90 | 0.001 033 3 | 381.17 | 1.1888 | 0.001 033 1 | 381.56 | 1.1884 | 0.001 032 8 | 381.95 | 1.1881 | 90 |
| 95 | 0.001 036 9 | 402.15 | 1.2461 | 0.001 036 7 | 402.53 | 1.2458 | 0.001 036 5 | 402.91 | 1.2454 | 95 |
| 100 | 0.001 040 7 | 423.16 | 1.3028 | 0.001 040 5 | 423.53 | 1.3024 | 0.001 040 2 | 423.91 | 1.3020 | 100 |
| 105 | 0.001 044 7 | 444.20 | 1.3588 | 0.001 044 4 | 444.57 | 1.3584 | 0.001 044 2 | 444.94 | 1.3580 | 105 |
| 110 | 0.001 048 7 | 465.27 | 1.4142 | 0.001 048 5 | 465.63 | 1.4138 | 0.001 048 2 | 466.00 | 1.4133 | 110 |
| 115 | 0.001 053 0 | 486.37 | 1.4689 | 0.001 052 7 | 486.73 | 1.4685 | 0.001 052 5 | 487.09 | 1.4680 | 115 |
| 120 | 0.001 057 4 | 507.52 | 1.5230 | 0.001 057 1 | 507.87 | 1.5226 | 0.001 056 8 | 508.22 | 1.5221 | 120 |
| 125 | 0.001 061 9 | 528.70 | 1.5766 | 0.001 061 6 | 529.05 | 1.5761 | 0.001 061 4 | 529.40 | 1.5757 | 125 |
| 130 | 0.001 066 6 | 549.94 | 1.6296 | 0.001 066 3 | 550.28 | 1.6291 | 0.001 066 1 | 550.62 | 1.6286 | 130 |
| 135 | 0.001 071 5 | 571.21 | 1.6820 | 0.001 071 2 | 571.55 | 1.6815 | 0.001 070 9 | 571.88 | 1.6810 | 135 |
| 140 | 0.001 076 5 | 592.54 | 1.7340 | 0.001 076 2 | 592.87 | 1.7335 | 0.001 075 9 | 593.20 | 1.7329 | 140 |
| 145 | 0.001 081 8 | 613.93 | 1.7854 | 0.001 081 4 | 614.25 | 1.7849 | 0.001 081 1 | 614.56 | 1.7844 | 145 |
| 150 | 0.001 087 2 | 635.37 | 1.8364 | 0.001 086 8 | 635.68 | 1.8358 | 0.001 086 5 | 635.99 | 1.8353 | 150 |
| 155 | 0.001 092 7 | 656.87 | 1.8869 | 0.001 092 4 | 657.17 | 1.8863 | 0.001 092 0 | 657.48 | 1.8858 | 155 |
| 160 | 0.001 098 5 | 678.44 | 1.9370 | 0.001 098 1 | 678.73 | 1.9364 | 0.001 097 8 | 679.03 | 1.9358 | 160 |
| 165 | 0.001 104 5 | 700.08 | 1.9867 | 0.001 104 1 | 700.37 | 1.9861 | 0.001 103 7 | 700.65 | 1.9855 | 165 |
| 170 | 0.001 110 6 | 721.80 | 2.0359 | 0.001 110 2 | 722.07 | 2.0353 | 0.001 109 9 | 722.35 | 2.0347 | 170 |
| 175 | 0.001 117 0 | 743.59 | 2.0849 | 0.001 116 6 | 743.86 | 2.0842 | 0.001 116 2 | 744.13 | 2.0836 | 175 |
| 180 | 0.001 123 6 | 765.48 | 2.1334 | 0.001 123 2 | 765.73 | 2.1327 | 0.001 122 8 | 765.99 | 2.1321 | 180 |
| 185 | 0.001 130 5 | 787.45 | 2.1816 | 0.001 130 0 | 787.70 | 2.1810 | 0.001 129 6 | 787.95 | 2.1803 | 185 |
| 190 | 0.001 137 6 | 809.53 | 2.2296 | 0.001 137 1 | 809.76 | 2.2289 | 0.001 136 7 | 810.00 | 2.2281 | 190 |
| 195 | 0.001 144 9 | 831.71 | 2.2772 | 0.001 144 4 | 831.93 | 2.2765 | 0.001 144 0 | 832.16 | 2.2757 | 195 |
| 200 | 0.001 152 5 | 854.01 | 2.3246 | 0.001 152 1 | 854.22 | 2.3238 | 0.001 151 6 | 854.43 | 2.3230 | 200 |
| 205 | 0.001 160 5 | 876.43 | 2.3717 | 0.001 160 0 | 876.62 | 2.3709 | 0.001 159 4 | 876.82 | 2.3701 | 205 |
| 210 | 0.001 168 7 | 898.98 | 2.4186 | 0.001 168 2 | 899.16 | 2.4178 | 0.001 167 6 | 899.34 | 2.4170 | 210 |
| 215 | 0.001 177 3 | 921.68 | 2.4654 | 0.001 176 7 | 921.84 | 2.4645 | 0.001 176 1 | 922.00 | 2.4636 | 215 |
| 220 | 0.001 186 2 | 944.53 | 2.5119 | 0.001 185 6 | 944.67 | 2.5110 | 0.001 185 0 | 944.82 | 2.5101 | 220 |
| 225 | 0.001 195 5 | 967.54 | 2.5584 | 0.001 194 9 | 967.67 | 2.5574 | 0.001 194 2 | 967.79 | 2.5565 | 225 |
| 230 | 0.001 205 | 990.74 | 2.6047 | 0.001 205 | 990.84 | 2.6037 | 0.001 204 | 990.95 | 2.6027 | 230 |
| 235 | 0.001 215 | 1014.1 | 2.6510 | 0.001 215 | 1014.2 | 2.6499 | 0.001 214 | 1014.3 | 2.6489 | 235 |
| 240 | 0.001 226 | 1037.7 | 2.6972 | 0.001 225 | 1037.8 | 2.6961 | 0.001 225 | 1037.8 | 2.6950 | 240 |
| 245 | 0.001 237 | 1061.6 | 2.7434 | 0.001 236 | 1061.6 | 2.7423 | 0.001 236 | 1061.6 | 2.7411 | 245 |
| 250 | 0.001 249 | 1085.7 | 2.7897 | 0.001 248 | 1085.7 | 2.7885 | 0.001 247 | 1085.6 | 2.7873 | 250 |
| 255 | 0.001 261 | 1110.0 | 2.8360 | 0.001 260 | 1110.0 | 2.8348 | 0.001 259 | 1109.9 | 2.8335 | 255 |
| 260 | 0.001 274 | 1134.7 | 2.8825 | 0.001 273 | 1134.6 | 2.8812 | 0.001 272 | 1134.5 | 2.8799 | 260 |
| 265 | 0.001 288 | 1159.7 | 2.9292 | 0.001 287 | 1159.6 | 2.9278 | 0.001 286 | 1159.5 | 2.9264 | 265 |
| 270 | 0.035 65 | 2789.9 | 5.9309 | 0.001 302 | 1184.9 | 2.9747 | 0.001 301 | 1184.8 | 2.9732 | 270 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 5.5 MPa ($t_{sat}$ = 269.97 °C) | | | 6.0 MPa ($t_{sat}$ = 275.59 °C) | | | 6.5 MPa ($t_{sat}$ = 280.86 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 0.036 53 | 2812.2 | 5.9718 | 0.001 317 | 1210.7 | 3.0219 | 0.001 316 | 1210.5 | 3.0203 | 275 |
| 280 | 0.037 37 | 2832.9 | 6.0094 | 0.033 20 | 2805.2 | 5.9276 | 0.001 333 | 1236.6 | 3.0678 | 280 |
| 285 | 0.038 16 | 2852.4 | 6.0446 | 0.034 00 | 2827.0 | 5.9668 | 0.030 41 | 2799.2 | 5.8881 | 285 |
| 290 | 0.038 93 | 2871.1 | 6.0779 | 0.034 76 | 2847.5 | 6.0033 | 0.031 18 | 2822.0 | 5.9287 | 290 |
| 295 | 0.039 66 | 2888.9 | 6.1094 | 0.035 49 | 2866.9 | 6.0377 | 0.031 91 | 2843.3 | 5.9664 | 295 |
| 300 | 0.040 37 | 2906.2 | 6.1396 | 0.036 19 | 2885.5 | 6.0702 | 0.032 61 | 2863.5 | 6.0018 | 300 |
| 310 | 0.041 74 | 2939.0 | 6.1965 | 0.037 52 | 2920.6 | 6.1309 | 0.033 92 | 2901.1 | 6.0670 | 310 |
| 320 | 0.043 04 | 2970.2 | 6.2495 | 0.038 78 | 2953.5 | 6.1870 | 0.035 15 | 2936.1 | 6.1265 | 320 |
| 330 | 0.044 30 | 3000.1 | 6.2994 | 0.039 98 | 2984.9 | 6.2393 | 0.036 32 | 2969.1 | 6.1816 | 330 |
| 340 | 0.045 50 | 3028.9 | 6.3468 | 0.041 14 | 3014.9 | 6.2887 | 0.037 43 | 3000.5 | 6.2332 | 340 |
| 350 | 0.046 68 | 3056.8 | 6.3919 | 0.042 25 | 3043.9 | 6.3356 | 0.038 50 | 3030.6 | 6.2819 | 350 |
| 360 | 0.047 82 | 3083.9 | 6.4352 | 0.043 34 | 3072.0 | 6.3803 | 0.039 53 | 3059.6 | 6.3282 | 360 |
| 370 | 0.048 94 | 3110.5 | 6.4768 | 0.044 39 | 3099.3 | 6.4232 | 0.040 54 | 3087.9 | 6.3724 | 370 |
| 380 | 0.050 03 | 3136.6 | 6.5170 | 0.045 42 | 3126.1 | 6.4645 | 0.041 51 | 3115.4 | 6.4149 | 380 |
| 390 | 0.051 10 | 3162.2 | 6.5560 | 0.046 43 | 3152.4 | 6.5044 | 0.042 47 | 3142.3 | 6.4558 | 390 |
| 400 | 0.052 16 | 3187.5 | 6.5938 | 0.047 42 | 3178.2 | 6.5431 | 0.043 41 | 3168.7 | 6.4953 | 400 |
| 410 | 0.053 20 | 3212.4 | 6.6306 | 0.048 40 | 3203.6 | 6.5806 | 0.044 33 | 3194.7 | 6.5336 | 410 |
| 420 | 0.054 23 | 3237.1 | 6.6665 | 0.049 36 | 3228.8 | 6.6171 | 0.045 23 | 3220.3 | 6.5709 | 420 |
| 430 | 0.055 24 | 3261.6 | 6.7015 | 0.050 31 | 3253.7 | 6.6528 | 0.046 13 | 3245.7 | 6.6071 | 430 |
| 440 | 0.056 25 | 3285.8 | 6.7358 | 0.051 24 | 3278.3 | 6.6876 | 0.047 00 | 3270.7 | 6.6425 | 440 |
| 450 | 0.057 24 | 3309.9 | 6.7693 | 0.052 17 | 3302.8 | 6.7216 | 0.047 87 | 3295.5 | 6.6771 | 450 |
| 460 | 0.058 23 | 3333.9 | 6.8022 | 0.053 08 | 3327.0 | 6.7550 | 0.048 73 | 3320.1 | 6.7109 | 460 |
| 470 | 0.059 20 | 3357.7 | 6.8345 | 0.053 99 | 3351.2 | 6.7877 | 0.049 58 | 3344.6 | 6.7440 | 470 |
| 480 | 0.060 17 | 3381.5 | 6.8663 | 0.054 89 | 3375.2 | 6.8198 | 0.050 43 | 3368.9 | 6.7765 | 480 |
| 490 | 0.061 13 | 3405.1 | 6.8975 | 0.055 79 | 3399.1 | 6.8513 | 0.051 26 | 3393.1 | 6.8084 | 490 |
| 500 | 0.062 09 | 3428.7 | 6.9282 | 0.056 67 | 3422.9 | 6.8824 | 0.052 09 | 3417.1 | 6.8397 | 500 |
| 510 | 0.063 04 | 3452.3 | 6.9584 | 0.057 55 | 3446.7 | 6.9129 | 0.052 91 | 3441.1 | 6.8705 | 510 |
| 520 | 0.063 98 | 3475.7 | 6.9882 | 0.058 43 | 3470.4 | 6.9429 | 0.053 73 | 3465.0 | 6.9008 | 520 |
| 530 | 0.064 92 | 3499.2 | 7.0176 | 0.059 30 | 3494.0 | 6.9726 | 0.054 54 | 3488.8 | 6.9307 | 530 |
| 540 | 0.065 85 | 3522.6 | 7.0466 | 0.060 16 | 3517.6 | 7.0018 | 0.055 34 | 3512.6 | 6.9601 | 540 |
| 550 | 0.066 78 | 3546.0 | 7.0751 | 0.061 02 | 3541.2 | 7.0306 | 0.056 15 | 3536.4 | 6.9892 | 550 |
| 560 | 0.067 71 | 3569.4 | 7.1034 | 0.061 88 | 3564.7 | 7.0590 | 0.056 94 | 3560.1 | 7.0178 | 560 |
| 570 | 0.068 63 | 3592.7 | 7.1312 | 0.062 73 | 3588.2 | 7.0870 | 0.057 74 | 3583.8 | 7.0460 | 570 |
| 580 | 0.069 55 | 3616.1 | 7.1588 | 0.063 58 | 3611.8 | 7.1148 | 0.058 53 | 3607.4 | 7.0739 | 580 |
| 590 | 0.070 46 | 3639.4 | 7.1860 | 0.064 42 | 3635.3 | 7.1421 | 0.059 31 | 3631.1 | 7.1015 | 590 |
| 600 | 0.071 37 | 3662.8 | 7.2129 | 0.065 26 | 3658.8 | 7.1692 | 0.060 10 | 3654.7 | 7.1287 | 600 |
| 610 | 0.072 28 | 3686.2 | 7.2395 | 0.066 10 | 3682.3 | 7.1960 | 0.060 88 | 3678.3 | 7.1556 | 610 |
| 620 | 0.073 19 | 3709.6 | 7.2659 | 0.066 94 | 3705.8 | 7.2224 | 0.061 65 | 3702.0 | 7.1822 | 620 |
| 630 | 0.074 09 | 3733.0 | 7.2919 | 0.067 77 | 3729.3 | 7.2486 | 0.062 43 | 3725.6 | 7.2085 | 630 |
| 640 | 0.074 99 | 3756.4 | 7.3177 | 0.068 60 | 3752.8 | 7.2745 | 0.063 20 | 3749.2 | 7.2346 | 640 |
| 650 | 0.075 89 | 3779.8 | 7.3432 | 0.069 43 | 3776.4 | 7.3002 | 0.063 97 | 3772.9 | 7.2603 | 650 |
| 660 | 0.076 78 | 3803.3 | 7.3685 | 0.070 26 | 3799.9 | 7.3256 | 0.064 73 | 3796.6 | 7.2859 | 660 |
| 670 | 0.077 68 | 3826.8 | 7.3936 | 0.071 08 | 3823.5 | 7.3507 | 0.065 50 | 3820.3 | 7.3111 | 670 |
| 680 | 0.078 57 | 3850.3 | 7.4184 | 0.071 90 | 3847.1 | 7.3756 | 0.066 26 | 3844.0 | 7.3361 | 680 |
| 690 | 0.079 46 | 3873.9 | 7.4430 | 0.072 72 | 3870.8 | 7.4003 | 0.067 02 | 3867.7 | 7.3609 | 690 |
| 700 | 0.080 35 | 3897.5 | 7.4673 | 0.073 54 | 3894.5 | 7.4248 | 0.067 78 | 3891.5 | 7.3854 | 700 |
| 710 | 0.081 23 | 3921.1 | 7.4915 | 0.074 36 | 3918.2 | 7.4490 | 0.068 54 | 3915.3 | 7.4098 | 710 |
| 720 | 0.082 12 | 3944.8 | 7.5154 | 0.075 17 | 3941.9 | 7.4730 | 0.069 30 | 3939.1 | 7.4339 | 720 |
| 730 | 0.083 00 | 3968.5 | 7.5392 | 0.075 99 | 3965.7 | 7.4969 | 0.070 05 | 3962.9 | 7.4578 | 730 |
| 740 | 0.083 88 | 3992.2 | 7.5627 | 0.076 80 | 3989.5 | 7.5205 | 0.070 80 | 3986.8 | 7.4815 | 740 |
| 750 | 0.084 76 | 4016.0 | 7.5861 | 0.077 61 | 4013.4 | 7.5439 | 0.071 55 | 4010.7 | 7.5050 | 750 |
| 760 | 0.085 64 | 4039.8 | 7.6093 | 0.078 42 | 4037.3 | 7.5672 | 0.072 30 | 4034.7 | 7.5283 | 760 |
| 770 | 0.086 52 | 4063.7 | 7.6323 | 0.079 23 | 4061.2 | 7.5902 | 0.073 05 | 4058.7 | 7.5514 | 770 |
| 780 | 0.087 40 | 4087.6 | 7.6551 | 0.080 03 | 4085.2 | 7.6131 | 0.073 80 | 4082.8 | 7.5743 | 780 |
| 790 | 0.088 27 | 4111.6 | 7.6777 | 0.080 84 | 4109.2 | 7.6358 | 0.074 55 | 4106.8 | 7.5971 | 790 |
| 800 | 0.089 15 | 4135.6 | 7.7002 | 0.081 64 | 4133.3 | 7.6583 | 0.075 29 | 4131.0 | 7.6196 | 800 |

UNITS: $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 7.0 MPa ($t_{sat}$ = 285.83 °C) | | | 7.5 MPa ($t_{sat}$ = 290.54 °C) | | | 8.0 MPa ($t_{sat}$ = 295.01 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 352 | 1267.4 | 3.1220 | 0.001 368 | 1292.7 | 3.1658 | 0.001 385 | 1317.1 | 3.2077 | Sat. Liq. |
| Sat. Vap. | 0.027 38 | 2772.6 | 5.8146 | 0.025 33 | 2765.8 | 5.7792 | 0.023 53 | 2758.6 | 5.7448 | Sat. Vap. |
| **0** | 0.000 996 7 | 7.05 | 0.0002 | 0.000 996 4 | 7.56 | 0.0002 | 0.000 996 2 | 8.06 | 0.0003 | **0** |
| **5** | 0.000 996 7 | 27.96 | 0.0761 | 0.000 996 4 | 28.45 | 0.0760 | 0.000 996 2 | 28.94 | 0.0760 | **5** |
| **10** | 0.000 997 0 | 48.82 | 0.1504 | 0.000 996 8 | 49.30 | 0.1504 | 0.000 996 6 | 49.79 | 0.1503 | **10** |
| **15** | 0.000 997 7 | 69.66 | 0.2234 | 0.000 997 5 | 70.14 | 0.2233 | 0.000 997 3 | 70.61 | 0.2232 | **15** |
| **20** | 0.000 998 7 | 90.48 | 0.2950 | 0.000 998 4 | 90.95 | 0.2949 | 0.000 998 2 | 91.42 | 0.2948 | **20** |
| **25** | 0.000 999 9 | 111.30 | 0.3654 | 0.000 999 6 | 111.76 | 0.3653 | 0.000 999 4 | 112.22 | 0.3652 | **25** |
| **30** | 0.001 001 3 | 132.11 | 0.4346 | 0.001 001 1 | 132.56 | 0.4345 | 0.001 000 9 | 133.02 | 0.4343 | **30** |
| **35** | 0.001 003 0 | 152.92 | 0.5027 | 0.001 002 7 | 153.37 | 0.5026 | 0.001 002 5 | 153.81 | 0.5024 | **35** |
| **40** | 0.001 004 8 | 173.73 | 0.5697 | 0.001 004 6 | 174.17 | 0.5695 | 0.001 004 4 | 174.61 | 0.5693 | **40** |
| **45** | 0.001 006 8 | 194.54 | 0.6356 | 0.001 006 6 | 194.97 | 0.6354 | 0.001 006 4 | 195.41 | 0.6352 | **45** |
| **50** | 0.001 009 1 | 215.36 | 0.7006 | 0.001 008 8 | 215.79 | 0.7003 | 0.001 008 6 | 216.22 | 0.7001 | **50** |
| **55** | 0.001 011 4 | 236.18 | 0.7645 | 0.001 011 2 | 236.60 | 0.7643 | 0.001 011 0 | 237.03 | 0.7640 | **55** |
| **60** | 0.001 014 0 | 257.01 | 0.8275 | 0.001 013 8 | 257.43 | 0.8273 | 0.001 013 6 | 257.85 | 0.8270 | **60** |
| **65** | 0.001 016 7 | 277.86 | 0.8896 | 0.001 016 5 | 278.27 | 0.8893 | 0.001 016 3 | 278.68 | 0.8891 | **65** |
| **70** | 0.001 019 6 | 298.71 | 0.9509 | 0.001 019 4 | 299.12 | 0.9506 | 0.001 019 1 | 299.53 | 0.9503 | **70** |
| **75** | 0.001 022 6 | 319.59 | 1.0112 | 0.001 022 4 | 319.99 | 1.0109 | 0.001 022 2 | 320.40 | 1.0106 | **75** |
| **80** | 0.001 025 8 | 340.48 | 1.0708 | 0.001 025 6 | 340.88 | 1.0705 | 0.001 025 3 | 341.28 | 1.0702 | **80** |
| **85** | 0.001 029 1 | 361.40 | 1.1296 | 0.001 028 9 | 361.79 | 1.1293 | 0.001 028 6 | 362.18 | 1.1290 | **85** |
| **90** | 0.001 032 6 | 382.33 | 1.1877 | 0.001 032 3 | 382.72 | 1.1873 | 0.001 032 1 | 383.11 | 1.1870 | **90** |
| **95** | 0.001 036 2 | 403.30 | 1.2450 | 0.001 036 0 | 403.68 | 1.2447 | 0.001 035 7 | 404.06 | 1.2443 | **95** |
| **100** | 0.001 040 0 | 424.29 | 1.3017 | 0.001 039 7 | 424.66 | 1.3013 | 0.001 039 5 | 425.04 | 1.3009 | **100** |
| **105** | 0.001 043 9 | 445.31 | 1.3576 | 0.001 043 6 | 445.68 | 1.3572 | 0.001 043 4 | 446.05 | 1.3568 | **105** |
| **110** | 0.001 048 0 | 466.36 | 1.4129 | 0.001 047 7 | 466.73 | 1.4125 | 0.001 047 4 | 467.09 | 1.4121 | **110** |
| **115** | 0.001 052 2 | 487.45 | 1.4676 | 0.001 051 9 | 487.81 | 1.4672 | 0.001 051 7 | 488.17 | 1.4668 | **115** |
| **120** | 0.001 056 6 | 508.58 | 1.5217 | 0.001 056 3 | 508.93 | 1.5213 | 0.001 056 0 | 509.28 | 1.5208 | **120** |
| **125** | 0.001 061 1 | 529.75 | 1.5752 | 0.001 060 8 | 530.09 | 1.5747 | 0.001 060 5 | 530.44 | 1.5743 | **125** |
| **130** | 0.001 065 8 | 550.96 | 1.6281 | 0.001 065 5 | 551.30 | 1.6277 | 0.001 065 2 | 551.64 | 1.6272 | **130** |
| **135** | 0.001 070 6 | 572.22 | 1.6805 | 0.001 070 3 | 572.55 | 1.6801 | 0.001 070 0 | 572.88 | 1.6796 | **135** |
| **140** | 0.001 075 6 | 593.52 | 1.7324 | 0.001 075 3 | 593.85 | 1.7319 | 0.001 075 0 | 594.18 | 1.7314 | **140** |
| **145** | 0.001 080 8 | 614.88 | 1.7838 | 0.001 080 5 | 615.20 | 1.7833 | 0.001 080 2 | 615.53 | 1.7828 | **145** |
| **150** | 0.001 086 2 | 636.30 | 1.8347 | 0.001 085 8 | 636.62 | 1.8342 | 0.001 085 5 | 636.93 | 1.8337 | **150** |
| **155** | 0.001 091 7 | 657.78 | 1.8852 | 0.001 091 4 | 658.09 | 1.8846 | 0.001 091 0 | 658.39 | 1.8841 | **155** |
| **160** | 0.001 097 4 | 679.33 | 1.9352 | 0.001 097 1 | 679.62 | 1.9347 | 0.001 096 7 | 679.92 | 1.9341 | **160** |
| **165** | 0.001 103 4 | 700.94 | 1.9849 | 0.001 103 0 | 701.23 | 1.9843 | 0.001 102 6 | 701.52 | 1.9837 | **165** |
| **170** | 0.001 109 5 | 722.63 | 2.0341 | 0.001 109 1 | 722.91 | 2.0334 | 0.001 108 7 | 723.19 | 2.0328 | **170** |
| **175** | 0.001 115 8 | 744.40 | 2.0829 | 0.001 115 4 | 744.67 | 2.0823 | 0.001 115 0 | 744.94 | 2.0816 | **175** |
| **180** | 0.001 122 4 | 766.25 | 2.1314 | 0.001 122 0 | 766.51 | 2.1307 | 0.001 121 6 | 766.77 | 2.1301 | **180** |
| **185** | 0.001 129 2 | 788.19 | 2.1796 | 0.001 128 8 | 788.44 | 2.1789 | 0.001 128 3 | 788.69 | 2.1782 | **185** |
| **190** | 0.001 136 2 | 810.23 | 2.2274 | 0.001 135 8 | 810.47 | 2.2267 | 0.001 135 3 | 810.71 | 2.2260 | **190** |
| **195** | 0.001 143 5 | 832.38 | 2.2750 | 0.001 143 0 | 832.60 | 2.2742 | 0.001 142 6 | 832.83 | 2.2735 | **195** |
| **200** | 0.001 151 1 | 854.64 | 2.3223 | 0.001 150 6 | 854.85 | 2.3215 | 0.001 150 1 | 855.06 | 2.3207 | **200** |
| **205** | 0.001 158 9 | 877.01 | 2.3693 | 0.001 158 4 | 877.21 | 2.3685 | 0.001 157 9 | 877.41 | 2.3677 | **205** |
| **210** | 0.001 167 1 | 899.52 | 2.4161 | 0.001 166 5 | 899.70 | 2.4153 | 0.001 166 0 | 899.89 | 2.4145 | **210** |
| **215** | 0.001 175 6 | 922.17 | 2.4628 | 0.001 175 0 | 922.33 | 2.4619 | 0.001 174 4 | 922.50 | 2.4610 | **215** |
| **220** | 0.001 184 4 | 944.96 | 2.5092 | 0.001 183 8 | 945.11 | 2.5083 | 0.001 183 2 | 945.26 | 2.5074 | **220** |
| **225** | 0.001 193 6 | 967.92 | 2.5555 | 0.001 193 0 | 968.05 | 2.5546 | 0.001 192 3 | 968.18 | 2.5537 | **225** |
| **230** | 0.001 203 | 991.05 | 2.6018 | 0.001 203 | 991.16 | 2.6008 | 0.001 202 | 991.27 | 2.5998 | **230** |
| **235** | 0.001 213 | 1014.4 | 2.6479 | 0.001 213 | 1014.5 | 2.6469 | 0.001 212 | 1014.5 | 2.6458 | **235** |
| **240** | 0.001 224 | 1037.9 | 2.6939 | 0.001 223 | 1038.0 | 2.6929 | 0.001 222 | 1038.0 | 2.6918 | **240** |
| **245** | 0.001 235 | 1061.7 | 2.7400 | 0.001 234 | 1061.7 | 2.7389 | 0.001 233 | 1061.7 | 2.7378 | **245** |
| **250** | 0.001 246 | 1085.6 | 2.7861 | 0.001 245 | 1085.7 | 2.7849 | 0.001 245 | 1085.7 | 2.7837 | **250** |
| **255** | 0.001 258 | 1109.9 | 2.8323 | 0.001 258 | 1109.9 | 2.8310 | 0.001 257 | 1109.9 | 2.8298 | **255** |
| **260** | 0.001 271 | 1134.5 | 2.8785 | 0.001 270 | 1134.4 | 2.8772 | 0.001 269 | 1134.3 | 2.8759 | **260** |
| **265** | 0.001 285 | 1159.4 | 2.9250 | 0.001 284 | 1159.2 | 2.9236 | 0.001 283 | 1159.1 | 2.9222 | **265** |
| **270** | 0.001 299 | 1184.6 | 2.9717 | 0.001 298 | 1184.4 | 2.9702 | 0.001 297 | 1184.3 | 2.9687 | **270** |

**UNITS**: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 7.0 MPa ($t_{sat}$ = 285.83 °C) | | | 7.5 MPa ($t_{sat}$ = 290.54 °C) | | | 8.0 MPa ($t_{sat}$ = 295.01 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 0.001 315 | 1210.2 | 3.0187 | 0.001 313 | 1210.0 | 3.0171 | 0.001 312 | 1209.8 | 3.0155 | 275 |
| 280 | 0.001 331 | 1236.3 | 3.0661 | 0.001 330 | 1236.1 | 3.0644 | 0.001 328 | 1235.8 | 3.0627 | 280 |
| 285 | 0.001 349 | 1263.0 | 3.1140 | 0.001 347 | 1262.6 | 3.1122 | 0.001 346 | 1262.3 | 3.1104 | 285 |
| 290 | 0.028 04 | 2794.0 | 5.8528 | 0.001 366 | 1289.7 | 3.1605 | 0.001 364 | 1289.3 | 3.1586 | 290 |
| 295 | 0.028 79 | 2817.7 | 5.8947 | 0.026 02 | 2789.7 | 5.8214 | 0.001 385 | 1317.0 | 3.2076 | 295 |
| 300 | 0.029 49 | 2839.8 | 5.9335 | 0.026 74 | 2814.3 | 5.8644 | 0.024 28 | 2786.4 | 5.7935 | 300 |
| 310 | 0.030 80 | 2880.6 | 6.0040 | 0.028 07 | 2858.7 | 5.9412 | 0.025 63 | 2835.3 | 5.8781 | 310 |
| 320 | 0.032 01 | 2917.9 | 6.0674 | 0.029 27 | 2898.6 | 6.0092 | 0.026 84 | 2878.4 | 5.9514 | 320 |
| 330 | 0.033 15 | 2952.6 | 6.1255 | 0.030 39 | 2935.5 | 6.0708 | 0.027 96 | 2917.5 | 6.0169 | 330 |
| 340 | 0.034 23 | 2985.5 | 6.1796 | 0.031 45 | 2970.0 | 6.1275 | 0.028 99 | 2953.9 | 6.0766 | 340 |
| 350 | 0.035 27 | 3016.8 | 6.2303 | 0.032 45 | 3002.7 | 6.1805 | 0.029 98 | 2988.1 | 6.1319 | 350 |
| 360 | 0.036 26 | 3047.0 | 6.2783 | 0.033 41 | 3034.0 | 6.2303 | 0.030 92 | 3020.6 | 6.1837 | 360 |
| 370 | 0.037 22 | 3076.1 | 6.3240 | 0.034 34 | 3064.1 | 6.2774 | 0.031 82 | 3051.7 | 6.2325 | 370 |
| 380 | 0.038 16 | 3104.4 | 6.3677 | 0.035 24 | 3093.2 | 6.3224 | 0.032 68 | 3081.8 | 6.2789 | 380 |
| 390 | 0.039 07 | 3132.1 | 6.4096 | 0.036 12 | 3121.6 | 6.3655 | 0.033 53 | 3110.9 | 6.3232 | 390 |
| 400 | 0.039 96 | 3159.1 | 6.4501 | 0.036 97 | 3149.3 | 6.4070 | 0.034 35 | 3139.3 | 6.3657 | 400 |
| 410 | 0.040 84 | 3185.6 | 6.4892 | 0.037 80 | 3176.4 | 6.4470 | 0.035 15 | 3167.0 | 6.4066 | 410 |
| 420 | 0.041 69 | 3211.8 | 6.5272 | 0.038 62 | 3203.1 | 6.4857 | 0.035 93 | 3194.2 | 6.4461 | 420 |
| 430 | 0.042 54 | 3237.5 | 6.5641 | 0.039 43 | 3229.3 | 6.5233 | 0.036 70 | 3220.9 | 6.4843 | 430 |
| 440 | 0.043 37 | 3263.0 | 6.6000 | 0.040 22 | 3255.2 | 6.5598 | 0.037 45 | 3247.3 | 6.5215 | 440 |
| 450 | 0.044 19 | 3288.2 | 6.6351 | 0.040 99 | 3280.7 | 6.5954 | 0.038 20 | 3273.2 | 6.5577 | 450 |
| 460 | 0.045 00 | 3313.1 | 6.6694 | 0.041 76 | 3306.1 | 6.6302 | 0.038 93 | 3298.9 | 6.5929 | 460 |
| 470 | 0.045 80 | 3337.9 | 6.7029 | 0.042 52 | 3331.1 | 6.6642 | 0.039 65 | 3324.3 | 6.6274 | 470 |
| 480 | 0.046 59 | 3362.5 | 6.7358 | 0.043 27 | 3356.0 | 6.6974 | 0.040 36 | 3349.5 | 6.6611 | 480 |
| 490 | 0.047 38 | 3386.9 | 6.7681 | 0.044 02 | 3380.8 | 6.7300 | 0.041 07 | 3374.5 | 6.6940 | 490 |
| 500 | 0.048 16 | 3411.3 | 6.7997 | 0.044 75 | 3405.3 | 6.7620 | 0.041 77 | 3399.4 | 6.7264 | 500 |
| 510 | 0.048 93 | 3435.5 | 6.8308 | 0.045 48 | 3429.8 | 6.7935 | 0.042 46 | 3424.1 | 6.7581 | 510 |
| 520 | 0.049 70 | 3459.6 | 6.8614 | 0.046 20 | 3454.1 | 6.8244 | 0.043 15 | 3448.6 | 6.7893 | 520 |
| 530 | 0.050 46 | 3483.6 | 6.8916 | 0.046 92 | 3478.4 | 6.8547 | 0.043 83 | 3473.1 | 6.8199 | 530 |
| 540 | 0.051 21 | 3507.6 | 6.9212 | 0.047 63 | 3502.6 | 6.8847 | 0.044 50 | 3497.5 | 6.8501 | 540 |
| 550 | 0.051 97 | 3531.5 | 6.9505 | 0.048 34 | 3526.7 | 6.9141 | 0.045 17 | 3521.8 | 6.8798 | 550 |
| 560 | 0.052 71 | 3555.4 | 6.9793 | 0.049 05 | 3550.7 | 6.9432 | 0.045 84 | 3546.0 | 6.9091 | 560 |
| 570 | 0.053 46 | 3579.2 | 7.0078 | 0.049 75 | 3574.7 | 6.9718 | 0.046 50 | 3570.2 | 6.9379 | 570 |
| 580 | 0.054 20 | 3603.1 | 7.0358 | 0.050 44 | 3598.7 | 7.0001 | 0.047 16 | 3594.3 | 6.9663 | 580 |
| 590 | 0.054 93 | 3626.8 | 7.0635 | 0.051 13 | 3622.6 | 7.0280 | 0.047 81 | 3618.4 | 6.9944 | 590 |
| 600 | 0.055 66 | 3650.6 | 7.0909 | 0.051 82 | 3646.5 | 7.0555 | 0.048 46 | 3642.4 | 7.0221 | 600 |
| 610 | 0.056 39 | 3674.4 | 7.1180 | 0.052 51 | 3670.4 | 7.0827 | 0.049 11 | 3666.4 | 7.0495 | 610 |
| 620 | 0.057 12 | 3698.1 | 7.1447 | 0.053 19 | 3694.3 | 7.1096 | 0.049 75 | 3690.5 | 7.0765 | 620 |
| 630 | 0.057 84 | 3721.9 | 7.1712 | 0.053 87 | 3718.2 | 7.1362 | 0.050 40 | 3714.5 | 7.1032 | 630 |
| 640 | 0.058 57 | 3745.6 | 7.1973 | 0.054 55 | 3742.0 | 7.1625 | 0.051 04 | 3738.4 | 7.1296 | 640 |
| 650 | 0.059 28 | 3769.4 | 7.2232 | 0.055 23 | 3765.9 | 7.1885 | 0.051 67 | 3762.4 | 7.1557 | 650 |
| 660 | 0.060 00 | 3793.2 | 7.2488 | 0.055 90 | 3789.8 | 7.2142 | 0.052 31 | 3786.4 | 7.1816 | 660 |
| 670 | 0.060 72 | 3817.0 | 7.2742 | 0.056 57 | 3813.7 | 7.2397 | 0.052 94 | 3810.4 | 7.2072 | 670 |
| 680 | 0.061 43 | 3840.8 | 7.2993 | 0.057 24 | 3837.6 | 7.2649 | 0.053 57 | 3834.4 | 7.2325 | 680 |
| 690 | 0.062 14 | 3864.6 | 7.3242 | 0.057 90 | 3861.5 | 7.2898 | 0.054 20 | 3858.4 | 7.2575 | 690 |
| 700 | 0.062 85 | 3888.5 | 7.3488 | 0.058 57 | 3885.4 | 7.3145 | 0.054 83 | 3882.4 | 7.2823 | 700 |
| 710 | 0.063 55 | 3912.3 | 7.3732 | 0.059 23 | 3909.4 | 7.3390 | 0.055 45 | 3906.5 | 7.3069 | 710 |
| 720 | 0.064 26 | 3936.2 | 7.3974 | 0.059 89 | 3933.4 | 7.3633 | 0.056 07 | 3930.5 | 7.3313 | 720 |
| 730 | 0.064 96 | 3960.2 | 7.4214 | 0.060 55 | 3957.4 | 7.3874 | 0.056 69 | 3954.6 | 7.3554 | 730 |
| 740 | 0.065 66 | 3984.1 | 7.4452 | 0.061 21 | 3981.4 | 7.4112 | 0.057 31 | 3978.7 | 7.3793 | 740 |
| 750 | 0.066 37 | 4008.1 | 7.4687 | 0.061 87 | 4005.5 | 7.4348 | 0.057 93 | 4002.9 | 7.4030 | 750 |
| 760 | 0.067 06 | 4032.2 | 7.4921 | 0.062 52 | 4029.6 | 7.4583 | 0.058 55 | 4027.0 | 7.4265 | 760 |
| 770 | 0.067 76 | 4056.2 | 7.5153 | 0.063 18 | 4053.7 | 7.4815 | 0.059 17 | 4051.2 | 7.4498 | 770 |
| 780 | 0.068 46 | 4080.3 | 7.5383 | 0.063 83 | 4077.9 | 7.5046 | 0.059 78 | 4075.5 | 7.4729 | 780 |
| 790 | 0.069 15 | 4104.5 | 7.5611 | 0.064 48 | 4102.1 | 7.5275 | 0.060 39 | 4099.7 | 7.4959 | 790 |
| 800 | 0.069 85 | 4128.6 | 7.5837 | 0.065 13 | 4126.3 | 7.5501 | 0.061 01 | 4124.0 | 7.5186 | 800 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 8.5 MPa ($t_{sat}$ = 299.27 °C) | | | 9.0 MPa ($t_{sat}$ = 303.35 °C) | | | 9.5 MPa ($t_{sat}$ = 307.25 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| Sat. Liq. | 0.001 401 | 1340.7 | 3.2478 | 0.001 418 | 1363.7 | 3.2866 | 0.001 435 | 1386.0 | 3.3240 | Sat. Liq. |
| Sat. Vap. | 0.021 93 | 2751.0 | 5.7115 | 0.020 49 | 2742.9 | 5.6790 | 0.019 20 | 2734.4 | 5.6472 | Sat. Vap. |
| 0 | 0.000 995 9 | 8.56 | 0.0003 | 0.000 995 7 | 9.06 | 0.0003 | 0.000 995 4 | 9.57 | 0.0003 | 0 |
| 5 | 0.000 996 0 | 29.43 | 0.0760 | 0.000 995 7 | 29.93 | 0.0760 | 0.000 995 5 | 30.42 | 0.0760 | 5 |
| 10 | 0.000 996 3 | 50.27 | 0.1503 | 0.000 996 1 | 50.75 | 0.1502 | 0.000 995 9 | 51.24 | 0.1501 | 10 |
| 15 | 0.000 997 0 | 71.08 | 0.2231 | 0.000 996 8 | 71.56 | 0.2230 | 0.000 996 6 | 72.03 | 0.2230 | 15 |
| 20 | 0.000 998 0 | 91.89 | 0.2947 | 0.000 997 8 | 92.35 | 0.2946 | 0.000 997 5 | 92.82 | 0.2945 | 20 |
| 25 | 0.000 999 2 | 112.68 | 0.3650 | 0.000 999 0 | 113.14 | 0.3649 | 0.000 998 8 | 113.60 | 0.3648 | 25 |
| 30 | 0.001 000 6 | 133.47 | 0.4342 | 0.001 000 4 | 133.92 | 0.4340 | 0.001 000 2 | 134.38 | 0.4339 | 30 |
| 35 | 0.001 002 3 | 154.26 | 0.5022 | 0.001 002 1 | 154.71 | 0.5020 | 0.001 001 9 | 155.15 | 0.5019 | 35 |
| 40 | 0.001 004 1 | 175.05 | 0.5691 | 0.001 003 9 | 175.49 | 0.5689 | 0.001 003 7 | 175.93 | 0.5687 | 40 |
| 45 | 0.001 006 2 | 195.85 | 0.6350 | 0.001 006 0 | 196.28 | 0.6348 | 0.001 005 8 | 196.72 | 0.6346 | 45 |
| 50 | 0.001 008 4 | 216.64 | 0.6999 | 0.001 008 2 | 217.07 | 0.6996 | 0.001 008 0 | 217.50 | 0.6994 | 50 |
| 55 | 0.001 010 8 | 237.45 | 0.7638 | 0.001 010 6 | 237.88 | 0.7635 | 0.001 010 4 | 238.30 | 0.7633 | 55 |
| 60 | 0.001 013 3 | 258.27 | 0.8267 | 0.001 013 1 | 258.69 | 0.8265 | 0.001 012 9 | 259.11 | 0.8262 | 60 |
| 65 | 0.001 016 0 | 279.10 | 0.8888 | 0.001 015 8 | 279.51 | 0.8885 | 0.001 015 6 | 279.93 | 0.8882 | 65 |
| 70 | 0.001 018 9 | 299.94 | 0.9500 | 0.001 018 7 | 300.35 | 0.9497 | 0.001 018 5 | 300.76 | 0.9494 | 70 |
| 75 | 0.001 021 9 | 320.80 | 1.0103 | 0.001 021 7 | 321.20 | 1.0100 | 0.001 021 5 | 321.61 | 1.0097 | 75 |
| 80 | 0.001 025 1 | 341.68 | 1.0699 | 0.001 024 9 | 342.08 | 1.0695 | 0.001 024 6 | 342.47 | 1.0692 | 80 |
| 85 | 0.001 028 4 | 362.58 | 1.1286 | 0.001 028 2 | 362.97 | 1.1283 | 0.001 027 9 | 363.36 | 1.1279 | 85 |
| 90 | 0.001 031 9 | 383.50 | 1.1866 | 0.001 031 6 | 383.88 | 1.1863 | 0.001 031 4 | 384.27 | 1.1859 | 90 |
| 95 | 0.001 035 5 | 404.44 | 1.2439 | 0.001 035 2 | 404.83 | 1.2436 | 0.001 035 0 | 405.21 | 1.2432 | 95 |
| 100 | 0.001 039 2 | 425.42 | 1.3005 | 0.001 039 0 | 425.79 | 1.3001 | 0.001 038 7 | 426.17 | 1.2997 | 100 |
| 105 | 0.001 043 1 | 446.42 | 1.3564 | 0.001 042 9 | 446.79 | 1.3560 | 0.001 042 6 | 447.16 | 1.3556 | 105 |
| 110 | 0.001 047 2 | 467.46 | 1.4117 | 0.001 046 9 | 467.82 | 1.4113 | 0.001 046 7 | 468.19 | 1.4109 | 110 |
| 115 | 0.001 051 4 | 488.53 | 1.4663 | 0.001 051 1 | 488.89 | 1.4659 | 0.001 050 9 | 489.25 | 1.4655 | 115 |
| 120 | 0.001 055 7 | 509.64 | 1.5204 | 0.001 055 5 | 509.99 | 1.5199 | 0.001 055 2 | 510.35 | 1.5195 | 120 |
| 125 | 0.001 060 2 | 530.79 | 1.5738 | 0.001 060 0 | 531.14 | 1.5734 | 0.001 059 7 | 531.48 | 1.5729 | 125 |
| 130 | 0.001 064 9 | 551.98 | 1.6267 | 0.001 064 6 | 552.32 | 1.6262 | 0.001 064 3 | 552.66 | 1.6258 | 130 |
| 135 | 0.001 069 7 | 573.22 | 1.6791 | 0.001 069 4 | 573.55 | 1.6786 | 0.001 069 1 | 573.89 | 1.6781 | 135 |
| 140 | 0.001 074 7 | 594.51 | 1.7309 | 0.001 074 4 | 594.83 | 1.7304 | 0.001 074 1 | 595.16 | 1.7299 | 140 |
| 145 | 0.001 079 9 | 615.85 | 1.7823 | 0.001 079 6 | 616.17 | 1.7817 | 0.001 079 2 | 616.49 | 1.7812 | 145 |
| 150 | 0.001 085 2 | 637.24 | 1.8331 | 0.001 084 9 | 637.56 | 1.8326 | 0.001 084 5 | 637.87 | 1.8320 | 150 |
| 155 | 0.001 090 7 | 658.70 | 1.8835 | 0.001 090 4 | 659.00 | 1.8830 | 0.001 090 0 | 659.31 | 1.8824 | 155 |
| 160 | 0.001 096 4 | 680.22 | 1.9335 | 0.001 096 0 | 680.52 | 1.9329 | 0.001 095 7 | 680.81 | 1.9323 | 160 |
| 165 | 0.001 102 3 | 701.81 | 1.9831 | 0.001 101 9 | 702.10 | 1.9825 | 0.001 101 6 | 702.38 | 1.9819 | 165 |
| 170 | 0.001 108 4 | 723.47 | 2.0322 | 0.001 108 0 | 723.75 | 2.0316 | 0.001 107 6 | 724.03 | 2.0310 | 170 |
| 175 | 0.001 114 7 | 745.21 | 2.0810 | 0.001 114 3 | 745.48 | 2.0804 | 0.001 113 9 | 745.75 | 2.0797 | 175 |
| 180 | 0.001 121 2 | 767.03 | 2.1294 | 0.001 120 8 | 767.29 | 2.1288 | 0.001 120 4 | 767.55 | 2.1281 | 180 |
| 185 | 0.001 127 9 | 788.94 | 2.1775 | 0.001 127 5 | 789.19 | 2.1768 | 0.001 127 1 | 789.44 | 2.1761 | 185 |
| 190 | 0.001 134 9 | 810.95 | 2.2253 | 0.001 134 4 | 811.19 | 2.2246 | 0.001 134 0 | 811.42 | 2.2239 | 190 |
| 195 | 0.001 142 1 | 833.06 | 2.2728 | 0.001 141 7 | 833.28 | 2.2720 | 0.001 141 2 | 833.51 | 2.2713 | 195 |
| 200 | 0.001 149 6 | 855.27 | 2.3200 | 0.001 149 1 | 855.49 | 2.3192 | 0.001 148 7 | 855.70 | 2.3184 | 200 |
| 205 | 0.001 157 4 | 877.61 | 2.3669 | 0.001 156 9 | 877.81 | 2.3661 | 0.001 156 4 | 878.01 | 2.3653 | 205 |
| 210 | 0.001 165 5 | 900.07 | 2.4137 | 0.001 164 9 | 900.26 | 2.4128 | 0.001 164 4 | 900.44 | 2.4120 | 210 |
| 215 | 0.001 173 9 | 922.67 | 2.4602 | 0.001 173 3 | 922.84 | 2.4593 | 0.001 172 8 | 923.01 | 2.4585 | 215 |
| 220 | 0.001 182 6 | 945.41 | 2.5065 | 0.001 182 0 | 945.57 | 2.5057 | 0.001 181 4 | 945.72 | 2.5048 | 220 |
| 225 | 0.001 191 7 | 968.31 | 2.5527 | 0.001 191 1 | 968.45 | 2.5518 | 0.001 190 5 | 968.58 | 2.5509 | 225 |
| 230 | 0.001 201 | 991.38 | 2.5988 | 0.001 201 | 991.50 | 2.5979 | 0.001 199 9 | 991.61 | 2.5969 | 230 |
| 235 | 0.001 211 | 1014.6 | 2.6448 | 0.001 210 | 1014.7 | 2.6438 | 0.001 210 | 1014.8 | 2.6428 | 235 |
| 240 | 0.001 221 | 1038.1 | 2.6907 | 0.001 221 | 1038.2 | 2.6897 | 0.001 220 | 1038.2 | 2.6886 | 240 |
| 245 | 0.001 232 | 1061.8 | 2.7367 | 0.001 232 | 1061.8 | 2.7355 | 0.001 231 | 1061.9 | 2.7344 | 245 |
| 250 | 0.001 244 | 1085.7 | 2.7826 | 0.001 243 | 1085.7 | 2.7814 | 0.001 242 | 1085.7 | 2.7802 | 250 |
| 255 | 0.001 256 | 1109.8 | 2.8285 | 0.001 255 | 1109.8 | 2.8273 | 0.001 254 | 1109.8 | 2.8261 | 255 |
| 260 | 0.001 268 | 1134.3 | 2.8746 | 0.001 267 | 1134.2 | 2.8733 | 0.001 266 | 1134.2 | 2.8720 | 260 |
| 265 | 0.001 282 | 1159.0 | 2.9208 | 0.001 281 | 1158.9 | 2.9195 | 0.001 279 | 1158.9 | 2.9181 | 265 |
| 270 | 0.001 296 | 1184.1 | 2.9673 | 0.001 295 | 1184.0 | 2.9658 | 0.001 293 | 1183.9 | 2.9644 | 270 |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 8.5 MPa ($t_{sat}$ = 299.27 °C) | | | 9.0 MPa ($t_{sat}$ = 303.35 °C) | | | 9.5 MPa ($t_{sat}$ = 307.25 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 0.001 311 | 1209.6 | 3.0140 | 0.001 310 | 1209.4 | 3.0124 | 0.001 308 | 1209.3 | 3.0109 | 275 |
| 280 | 0.001 327 | 1235.5 | 3.0610 | 0.001 325 | 1235.3 | 3.0594 | 0.001 324 | 1235.1 | 3.0577 | 280 |
| 285 | 0.001 344 | 1262.0 | 3.1086 | 0.001 342 | 1261.6 | 3.1068 | 0.001 341 | 1261.3 | 3.1050 | 285 |
| 290 | 0.001 363 | 1288.9 | 3.1566 | 0.001 361 | 1288.5 | 3.1547 | 0.001 359 | 1288.1 | 3.1528 | 290 |
| 295 | 0.001 383 | 1316.5 | 3.2054 | 0.001 381 | 1316.0 | 3.2034 | 0.001 379 | 1315.5 | 3.2013 | 295 |
| 300 | 0.022 04 | 2755.4 | 5.7193 | 0.001 402 | 1344.3 | 3.2529 | 0.001 400 | 1343.7 | 3.2506 | 300 |
| 310 | 0.023 44 | 2810.0 | 5.8138 | 0.021 45 | 2782.6 | 5.7475 | 0.019 61 | 2752.4 | 5.6781 | 310 |
| 320 | 0.024 67 | 2856.8 | 5.8934 | 0.022 71 | 2833.9 | 5.8348 | 0.020 92 | 2809.3 | 5.7749 | 320 |
| 330 | 0.025 78 | 2898.7 | 5.9634 | 0.023 83 | 2878.9 | 5.9100 | 0.022 06 | 2857.9 | 5.8562 | 330 |
| 340 | 0.026 82 | 2937.1 | 6.0265 | 0.024 86 | 2919.6 | 5.9769 | 0.023 10 | 2901.3 | 5.9275 | 340 |
| 350 | 0.027 78 | 2972.9 | 6.0845 | 0.025 82 | 2957.2 | 6.0378 | 0.024 05 | 2940.9 | 5.9917 | 350 |
| 360 | 0.028 70 | 3006.8 | 6.1384 | 0.026 72 | 2992.5 | 6.0940 | 0.024 94 | 2977.8 | 6.0504 | 360 |
| 370 | 0.029 58 | 3039.0 | 6.1890 | 0.027 58 | 3026.0 | 6.1465 | 0.025 78 | 3012.6 | 6.1049 | 370 |
| 380 | 0.030 42 | 3070.1 | 6.2368 | 0.028 40 | 3058.0 | 6.1959 | 0.026 59 | 3045.7 | 6.1560 | 380 |
| 390 | 0.031 24 | 3100.0 | 6.2824 | 0.029 20 | 3088.9 | 6.2428 | 0.027 36 | 3077.5 | 6.2043 | 390 |
| 400 | 0.032 03 | 3129.1 | 6.3259 | 0.029 96 | 3118.8 | 6.2875 | 0.028 11 | 3108.2 | 6.2502 | 400 |
| 410 | 0.032 80 | 3157.5 | 6.3678 | 0.030 71 | 3147.8 | 6.3303 | 0.028 84 | 3137.9 | 6.2941 | 410 |
| 420 | 0.033 55 | 3185.3 | 6.4081 | 0.031 44 | 3176.1 | 6.3715 | 0.029 54 | 3166.9 | 6.3362 | 420 |
| 430 | 0.034 29 | 3212.5 | 6.4471 | 0.032 15 | 3203.9 | 6.4113 | 0.030 23 | 3195.2 | 6.3767 | 430 |
| 440 | 0.035 01 | 3239.2 | 6.4849 | 0.032 84 | 3231.1 | 6.4497 | 0.030 90 | 3222.9 | 6.4159 | 440 |
| 450 | 0.035 73 | 3265.6 | 6.5216 | 0.033 53 | 3257.9 | 6.4871 | 0.031 56 | 3250.2 | 6.4538 | 450 |
| 460 | 0.036 43 | 3291.7 | 6.5574 | 0.034 20 | 3284.4 | 6.5234 | 0.032 21 | 3277.0 | 6.4907 | 460 |
| 470 | 0.037 12 | 3317.4 | 6.5923 | 0.034 86 | 3310.5 | 6.5588 | 0.032 84 | 3303.5 | 6.5265 | 470 |
| 480 | 0.037 80 | 3343.0 | 6.6264 | 0.035 51 | 3336.3 | 6.5933 | 0.033 47 | 3329.6 | 6.5615 | 480 |
| 490 | 0.038 47 | 3368.3 | 6.6598 | 0.036 16 | 3361.9 | 6.6271 | 0.034 09 | 3355.5 | 6.5957 | 490 |
| 500 | 0.039 14 | 3393.4 | 6.6925 | 0.036 80 | 3387.3 | 6.6601 | 0.034 70 | 3381.2 | 6.6291 | 500 |
| 510 | 0.039 80 | 3418.3 | 6.7245 | 0.037 43 | 3412.5 | 6.6925 | 0.035 30 | 3406.7 | 6.6618 | 510 |
| 520 | 0.040 45 | 3443.1 | 6.7560 | 0.038 05 | 3437.6 | 6.7243 | 0.035 90 | 3431.9 | 6.6939 | 520 |
| 530 | 0.041 10 | 3467.8 | 6.7869 | 0.038 67 | 3462.5 | 6.7555 | 0.036 49 | 3457.1 | 6.7254 | 530 |
| 540 | 0.041 74 | 3492.4 | 6.8173 | 0.039 28 | 3487.2 | 6.7861 | 0.037 08 | 3482.1 | 6.7563 | 540 |
| 550 | 0.042 37 | 3516.9 | 6.8473 | 0.039 89 | 3511.9 | 6.8163 | 0.037 66 | 3506.9 | 6.7867 | 550 |
| 560 | 0.043 01 | 3541.3 | 6.8767 | 0.040 49 | 3536.5 | 6.8460 | 0.038 24 | 3531.7 | 6.8166 | 560 |
| 570 | 0.043 63 | 3565.6 | 6.9058 | 0.041 09 | 3561.0 | 6.8752 | 0.038 81 | 3556.4 | 6.8461 | 570 |
| 580 | 0.044 26 | 3589.9 | 6.9344 | 0.041 68 | 3585.4 | 6.9040 | 0.039 38 | 3581.0 | 6.8751 | 580 |
| 590 | 0.044 88 | 3614.1 | 6.9626 | 0.042 27 | 3609.8 | 6.9324 | 0.039 94 | 3605.5 | 6.9037 | 590 |
| 600 | 0.045 50 | 3638.3 | 6.9905 | 0.042 86 | 3634.2 | 6.9605 | 0.040 50 | 3630.0 | 6.9319 | 600 |
| 610 | 0.046 11 | 3662.5 | 7.0180 | 0.043 44 | 3658.5 | 6.9881 | 0.041 06 | 3654.4 | 6.9597 | 610 |
| 620 | 0.046 72 | 3686.6 | 7.0452 | 0.044 03 | 3682.7 | 7.0155 | 0.041 61 | 3678.8 | 6.9872 | 620 |
| 630 | 0.047 33 | 3710.7 | 7.0720 | 0.044 60 | 3707.0 | 7.0424 | 0.042 16 | 3703.2 | 7.0143 | 630 |
| 640 | 0.047 94 | 3734.8 | 7.0986 | 0.045 18 | 3731.2 | 7.0691 | 0.042 71 | 3727.5 | 7.0411 | 640 |
| 650 | 0.048 54 | 3758.9 | 7.1248 | 0.045 75 | 3755.4 | 7.0955 | 0.043 26 | 3751.9 | 7.0676 | 650 |
| 660 | 0.049 14 | 3783.0 | 7.1508 | 0.046 32 | 3779.6 | 7.1216 | 0.043 80 | 3776.2 | 7.0937 | 660 |
| 670 | 0.049 74 | 3807.1 | 7.1764 | 0.046 89 | 3803.8 | 7.1473 | 0.044 35 | 3800.5 | 7.1196 | 670 |
| 680 | 0.050 33 | 3831.2 | 7.2019 | 0.047 46 | 3828.0 | 7.1728 | 0.044 89 | 3824.7 | 7.1453 | 680 |
| 690 | 0.050 93 | 3855.3 | 7.2270 | 0.048 02 | 3852.2 | 7.1981 | 0.045 42 | 3849.0 | 7.1706 | 690 |
| 700 | 0.051 52 | 3879.4 | 7.2519 | 0.048 59 | 3876.4 | 7.2231 | 0.045 96 | 3873.3 | 7.1957 | 700 |
| 710 | 0.052 11 | 3903.5 | 7.2766 | 0.049 15 | 3900.6 | 7.2478 | 0.046 49 | 3897.6 | 7.2205 | 710 |
| 720 | 0.052 70 | 3927.7 | 7.3010 | 0.049 71 | 3924.8 | 7.2724 | 0.047 02 | 3921.9 | 7.2451 | 720 |
| 730 | 0.053 29 | 3951.8 | 7.3252 | 0.050 26 | 3949.0 | 7.2967 | 0.047 56 | 3946.2 | 7.2695 | 730 |
| 740 | 0.053 88 | 3976.0 | 7.3492 | 0.050 82 | 3973.3 | 7.3207 | 0.048 08 | 3970.6 | 7.2936 | 740 |
| 750 | 0.054 46 | 4000.2 | 7.3730 | 0.051 37 | 3997.6 | 7.3446 | 0.048 61 | 3994.9 | 7.3176 | 750 |
| 760 | 0.055 04 | 4024.5 | 7.3966 | 0.051 93 | 4021.9 | 7.3682 | 0.049 14 | 4019.3 | 7.3413 | 760 |
| 770 | 0.055 63 | 4048.7 | 7.4199 | 0.052 48 | 4046.2 | 7.3916 | 0.049 66 | 4043.7 | 7.3648 | 770 |
| 780 | 0.056 21 | 4073.0 | 7.4431 | 0.053 03 | 4070.6 | 7.4149 | 0.050 19 | 4068.1 | 7.3881 | 780 |
| 790 | 0.056 79 | 4097.3 | 7.4661 | 0.053 58 | 4095.0 | 7.4379 | 0.050 71 | 4092.6 | 7.4112 | 790 |
| 800 | 0.057 36 | 4121.7 | 7.4889 | 0.054 13 | 4119.4 | 7.4608 | 0.051 23 | 4117.0 | 7.4341 | 800 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 10 MPa ($t_{sat}$ = 311.00 °C) | | | 11 MPa ($t_{sat}$ = 318.08 °C) | | | 12 MPa ($t_{sat}$ = 324.68 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 453 | 1407.9 | 3.3603 | 0.001 489 | 1450.3 | 3.4300 | 0.001 526 | 1491.3 | 3.4965 | Sat. Liq. |
| Sat. Vap. | 0.018 03 | 2725.5 | 5.6159 | 0.015 99 | 2706.4 | 5.5545 | 0.014 27 | 2685.6 | 5.4941 | Sat. Vap. |
| **0** | 0.000 995 2 | 10.07 | 0.0003 | 0.000 994 7 | 11.07 | 0.0004 | 0.000 994 2 | 12.07 | 0.0004 | **0** |
| **5** | 0.000 995 2 | 30.91 | 0.0759 | 0.000 994 8 | 31.89 | 0.0759 | 0.000 994 3 | 32.87 | 0.0758 | **5** |
| **10** | 0.000 995 6 | 51.72 | 0.1501 | 0.000 995 2 | 52.68 | 0.1500 | 0.000 994 7 | 53.64 | 0.1499 | **10** |
| **15** | 0.000 996 3 | 72.51 | 0.2229 | 0.000 995 9 | 73.45 | 0.2227 | 0.000 995 4 | 74.40 | 0.2225 | **15** |
| **20** | 0.000 997 3 | 93.29 | 0.2944 | 0.000 996 9 | 94.22 | 0.2941 | 0.000 996 4 | 95.15 | 0.2939 | **20** |
| **25** | 0.000 998 5 | 114.06 | 0.3646 | 0.000 998 1 | 114.98 | 0.3644 | 0.000 997 7 | 115.90 | 0.3641 | **25** |
| **30** | 0.001 000 0 | 134.83 | 0.4337 | 0.000 999 6 | 135.74 | 0.4334 | 0.000 999 1 | 136.64 | 0.4331 | **30** |
| **35** | 0.001 001 6 | 155.60 | 0.5017 | 0.001 001 2 | 156.49 | 0.5013 | 0.001 000 8 | 157.39 | 0.5010 | **35** |
| **40** | 0.001 003 5 | 176.37 | 0.5685 | 0.001 003 1 | 177.26 | 0.5682 | 0.001 002 6 | 178.14 | 0.5678 | **40** |
| **45** | 0.001 005 5 | 197.15 | 0.6344 | 0.001 005 1 | 198.02 | 0.6339 | 0.001 004 7 | 198.89 | 0.6335 | **45** |
| **50** | 0.001 007 8 | 217.93 | 0.6992 | 0.001 007 3 | 218.79 | 0.6987 | 0.001 006 9 | 219.65 | 0.6983 | **50** |
| **55** | 0.001 010 1 | 238.72 | 0.7630 | 0.001 009 7 | 239.57 | 0.7625 | 0.001 009 3 | 240.42 | 0.7620 | **55** |
| **60** | 0.001 012 7 | 259.53 | 0.8259 | 0.001 012 2 | 260.36 | 0.8254 | 0.001 011 8 | 261.20 | 0.8249 | **60** |
| **65** | 0.001 015 4 | 280.34 | 0.8880 | 0.001 014 9 | 281.17 | 0.8874 | 0.001 014 5 | 281.99 | 0.8868 | **65** |
| **70** | 0.001 018 2 | 301.17 | 0.9491 | 0.001 017 8 | 301.98 | 0.9485 | 0.001 017 3 | 302.80 | 0.9479 | **70** |
| **75** | 0.001 021 2 | 322.01 | 1.0094 | 0.001 020 8 | 322.82 | 1.0088 | 0.001 020 3 | 323.62 | 1.0082 | **75** |
| **80** | 0.001 024 4 | 342.87 | 1.0689 | 0.001 023 9 | 343.67 | 1.0682 | 0.001 023 5 | 344.46 | 1.0676 | **80** |
| **85** | 0.001 027 7 | 363.75 | 1.1276 | 0.001 027 2 | 364.54 | 1.1269 | 0.001 026 8 | 365.33 | 1.1263 | **85** |
| **90** | 0.001 031 2 | 384.66 | 1.1856 | 0.001 030 7 | 385.43 | 1.1849 | 0.001 030 2 | 386.21 | 1.1842 | **90** |
| **95** | 0.001 034 8 | 405.59 | 1.2428 | 0.001 034 3 | 406.35 | 1.2421 | 0.001 033 8 | 407.12 | 1.2414 | **95** |
| **100** | 0.001 038 5 | 426.55 | 1.2994 | 0.001 038 0 | 427.30 | 1.2986 | 0.001 037 5 | 428.06 | 1.2978 | **100** |
| **105** | 0.001 042 4 | 447.54 | 1.3552 | 0.001 041 9 | 448.28 | 1.3544 | 0.001 041 4 | 449.02 | 1.3537 | **105** |
| **110** | 0.001 046 4 | 468.56 | 1.4105 | 0.001 045 9 | 469.29 | 1.4096 | 0.001 045 4 | 470.02 | 1.4088 | **110** |
| **115** | 0.001 050 6 | 489.61 | 1.4650 | 0.001 050 1 | 490.33 | 1.4642 | 0.001 049 5 | 491.05 | 1.4634 | **115** |
| **120** | 0.001 054 9 | 510.70 | 1.5190 | 0.001 054 4 | 511.41 | 1.5182 | 0.001 053 9 | 512.12 | 1.5173 | **120** |
| **125** | 0.001 059 4 | 531.83 | 1.5724 | 0.001 058 9 | 532.53 | 1.5715 | 0.001 058 3 | 533.23 | 1.5706 | **125** |
| **130** | 0.001 064 0 | 553.00 | 1.6253 | 0.001 063 5 | 553.69 | 1.6244 | 0.001 062 9 | 554.37 | 1.6234 | **130** |
| **135** | 0.001 068 8 | 574.22 | 1.6776 | 0.001 068 3 | 574.89 | 1.6766 | 0.001 067 7 | 575.57 | 1.6757 | **135** |
| **140** | 0.001 073 8 | 595.49 | 1.7294 | 0.001 073 2 | 596.15 | 1.7284 | 0.001 072 6 | 596.81 | 1.7274 | **140** |
| **145** | 0.001 078 9 | 616.81 | 1.7807 | 0.001 078 3 | 617.45 | 1.7796 | 0.001 077 7 | 618.10 | 1.7786 | **145** |
| **150** | 0.001 084 2 | 638.18 | 1.8315 | 0.001 083 6 | 638.81 | 1.8304 | 0.001 082 9 | 639.44 | 1.8294 | **150** |
| **155** | 0.001 089 7 | 659.62 | 1.8819 | 0.001 089 0 | 660.23 | 1.8807 | 0.001 088 4 | 660.85 | 1.8796 | **155** |
| **160** | 0.001 095 4 | 681.11 | 1.9318 | 0.001 094 7 | 681.71 | 1.9306 | 0.001 094 0 | 682.31 | 1.9295 | **160** |
| **165** | 0.001 101 2 | 702.67 | 1.9813 | 0.001 100 5 | 703.26 | 1.9801 | 0.001 099 8 | 703.84 | 1.9789 | **165** |
| **170** | 0.001 107 2 | 724.31 | 2.0304 | 0.001 106 5 | 724.87 | 2.0291 | 0.001 105 8 | 725.44 | 2.0279 | **170** |
| **175** | 0.001 113 5 | 746.02 | 2.0791 | 0.001 112 7 | 746.56 | 2.0778 | 0.001 112 0 | 747.11 | 2.0765 | **175** |
| **180** | 0.001 120 0 | 767.81 | 2.1274 | 0.001 119 2 | 768.34 | 2.1261 | 0.001 118 4 | 768.86 | 2.1248 | **180** |
| **185** | 0.001 126 6 | 789.69 | 2.1755 | 0.001 125 8 | 790.20 | 2.1741 | 0.001 125 0 | 790.70 | 2.1727 | **185** |
| **190** | 0.001 133 6 | 811.66 | 2.2232 | 0.001 132 7 | 812.15 | 2.2217 | 0.001 131 8 | 812.63 | 2.2204 | **190** |
| **195** | 0.001 140 7 | 833.74 | 2.2706 | 0.001 139 8 | 834.20 | 2.2691 | 0.001 138 9 | 834.66 | 2.2677 | **195** |
| **200** | 0.001 148 2 | 855.92 | 2.3177 | 0.001 147 2 | 856.35 | 2.3162 | 0.001 146 3 | 856.79 | 2.3147 | **200** |
| **205** | 0.001 155 9 | 878.21 | 2.3646 | 0.001 154 9 | 878.62 | 2.3630 | 0.001 153 9 | 879.03 | 2.3614 | **205** |
| **210** | 0.001 163 9 | 900.63 | 2.4112 | 0.001 162 8 | 901.01 | 2.4096 | 0.001 161 8 | 901.39 | 2.4080 | **210** |
| **215** | 0.001 172 2 | 923.18 | 2.4576 | 0.001 171 1 | 923.53 | 2.4559 | 0.001 170 0 | 923.88 | 2.4543 | **215** |
| **220** | 0.001 180 8 | 945.87 | 2.5039 | 0.001 179 7 | 946.19 | 2.5021 | 0.001 178 5 | 946.51 | 2.5004 | **220** |
| **225** | 0.001 189 8 | 968.72 | 2.5500 | 0.001 188 6 | 969.00 | 2.5481 | 0.001 187 4 | 969.28 | 2.5463 | **225** |
| **230** | 0.001 199 2 | 991.73 | 2.5959 | 0.001 197 9 | 991.97 | 2.5940 | 0.001 196 6 | 992.21 | 2.5921 | **230** |
| **235** | 0.001 209 | 1014.9 | 2.6418 | 0.001 208 | 1015.1 | 2.6398 | 0.001 206 | 1015.3 | 2.6378 | **235** |
| **240** | 0.001 219 | 1038.3 | 2.6876 | 0.001 218 | 1038.5 | 2.6855 | 0.001 216 | 1038.6 | 2.6834 | **240** |
| **245** | 0.001 230 | 1061.9 | 2.7333 | 0.001 228 | 1062.0 | 2.7312 | 0.001 227 | 1062.1 | 2.7290 | **245** |
| **250** | 0.001 241 | 1085.7 | 2.7791 | 0.001 239 | 1085.8 | 2.7768 | 0.001 238 | 1085.8 | 2.7745 | **250** |
| **255** | 0.001 253 | 1109.8 | 2.8249 | 0.001 251 | 1109.8 | 2.8225 | 0.001 249 | 1109.8 | 2.8201 | **255** |
| **260** | 0.001 265 | 1134.1 | 2.8708 | 0.001 263 | 1134.0 | 2.8682 | 0.001 262 | 1134.0 | 2.8657 | **260** |
| **265** | 0.001 278 | 1158.8 | 2.9168 | 0.001 276 | 1158.6 | 2.9141 | 0.001 274 | 1158.5 | 2.9114 | **265** |
| **270** | 0.001 292 | 1183.7 | 2.9629 | 0.001 290 | 1183.5 | 2.9601 | 0.001 288 | 1183.3 | 2.9573 | **270** |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 10 MPa ($t_{sat}$ = 311.00 °C) | | | 11 MPa ($t_{sat}$ = 318.08 °C) | | | 12 MPa ($t_{sat}$ = 324.68 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| 275 | 0.001 307 | 1209.1 | 3.0094 | 0.001 305 | 1208.7 | 3.0064 | 0.001 302 | 1208.4 | 3.0034 | 275 |
| 280 | 0.001 323 | 1234.8 | 3.0561 | 0.001 320 | 1234.4 | 3.0529 | 0.001 317 | 1233.9 | 3.0498 | 280 |
| 285 | 0.001 339 | 1261.0 | 3.1033 | 0.001 336 | 1260.4 | 3.0998 | 0.001 333 | 1259.9 | 3.0965 | 285 |
| 290 | 0.001 357 | 1287.7 | 3.1510 | 0.001 354 | 1287.0 | 3.1473 | 0.001 351 | 1286.3 | 3.1436 | 290 |
| 295 | 0.001 377 | 1315.1 | 3.1993 | 0.001 373 | 1314.2 | 3.1953 | 0.001 370 | 1313.3 | 3.1913 | 295 |
| 300 | 0.001 398 | 1343.1 | 3.2484 | 0.001 394 | 1342.0 | 3.2440 | 0.001 390 | 1340.9 | 3.2397 | 300 |
| 310 | 0.001 447 | 1401.8 | 3.3498 | 0.001 442 | 1400.1 | 3.3445 | 0.001 436 | 1398.5 | 3.3393 | 310 |
| 320 | 0.019 27 | 2782.7 | 5.7131 | 0.016 28 | 2721.1 | 5.5793 | 0.001 494 | 1460.3 | 3.4444 | 320 |
| 330 | 0.020 45 | 2835.7 | 5.8017 | 0.017 57 | 2786.4 | 5.6885 | 0.015 02 | 2728.1 | 5.5650 | 330 |
| 340 | 0.021 49 | 2882.1 | 5.8780 | 0.018 66 | 2840.4 | 5.7775 | 0.016 21 | 2793.5 | 5.6725 | 340 |
| 350 | 0.022 44 | 2924.0 | 5.9458 | 0.019 63 | 2887.8 | 5.8541 | 0.017 22 | 2848.0 | 5.7607 | 350 |
| 360 | 0.023 33 | 2962.6 | 6.0073 | 0.020 51 | 2930.5 | 5.9221 | 0.018 12 | 2895.9 | 5.8369 | 360 |
| 370 | 0.024 16 | 2998.8 | 6.0641 | 0.021 33 | 2969.9 | 5.9839 | 0.018 94 | 2939.1 | 5.9047 | 370 |
| 380 | 0.024 95 | 3033.1 | 6.1170 | 0.022 10 | 3006.8 | 6.0408 | 0.019 71 | 2979.1 | 5.9664 | 380 |
| 390 | 0.025 71 | 3065.9 | 6.1668 | 0.022 84 | 3041.8 | 6.0939 | 0.020 43 | 3016.5 | 6.0232 | 390 |
| 400 | 0.026 44 | 3097.4 | 6.2139 | 0.023 54 | 3075.1 | 6.1438 | 0.021 11 | 3051.9 | 6.0762 | 400 |
| 410 | 0.027 14 | 3127.8 | 6.2589 | 0.024 21 | 3107.2 | 6.1911 | 0.021 76 | 3085.7 | 6.1261 | 410 |
| 420 | 0.027 83 | 3157.5 | 6.3019 | 0.024 87 | 3138.1 | 6.2361 | 0.022 39 | 3118.2 | 6.1733 | 420 |
| 430 | 0.028 50 | 3186.3 | 6.3432 | 0.025 50 | 3168.2 | 6.2792 | 0.022 99 | 3149.6 | 6.2182 | 430 |
| 440 | 0.029 15 | 3214.6 | 6.3831 | 0.026 11 | 3197.6 | 6.3206 | 0.023 58 | 3180.1 | 6.2613 | 440 |
| 450 | 0.029 78 | 3242.3 | 6.4217 | 0.026 72 | 3226.2 | 6.3605 | 0.024 15 | 3209.8 | 6.3027 | 450 |
| 460 | 0.030 41 | 3269.5 | 6.4591 | 0.027 30 | 3254.3 | 6.3991 | 0.024 71 | 3238.8 | 6.3425 | 460 |
| 470 | 0.031 02 | 3296.4 | 6.4955 | 0.027 88 | 3282.0 | 6.4366 | 0.025 25 | 3267.3 | 6.3811 | 470 |
| 480 | 0.031 63 | 3322.9 | 6.5310 | 0.028 45 | 3309.2 | 6.4730 | 0.025 79 | 3295.2 | 6.4185 | 480 |
| 490 | 0.032 23 | 3349.1 | 6.5655 | 0.029 00 | 3336.1 | 6.5084 | 0.026 31 | 3322.8 | 6.4548 | 490 |
| 500 | 0.032 81 | 3375.1 | 6.5993 | 0.029 55 | 3362.6 | 6.5430 | 0.026 83 | 3350.0 | 6.4902 | 500 |
| 510 | 0.033 39 | 3400.8 | 6.6324 | 0.030 09 | 3388.9 | 6.5767 | 0.027 34 | 3376.8 | 6.5247 | 510 |
| 520 | 0.033 97 | 3426.3 | 6.6648 | 0.030 63 | 3414.9 | 6.6098 | 0.027 84 | 3403.4 | 6.5584 | 520 |
| 530 | 0.034 54 | 3451.7 | 6.6965 | 0.031 15 | 3440.7 | 6.6421 | 0.028 33 | 3429.7 | 6.5914 | 530 |
| 540 | 0.035 10 | 3476.9 | 6.7277 | 0.031 68 | 3466.4 | 6.6738 | 0.028 82 | 3455.8 | 6.6237 | 540 |
| 550 | 0.035 66 | 3501.9 | 6.7584 | 0.032 19 | 3491.9 | 6.7050 | 0.029 30 | 3481.7 | 6.6553 | 550 |
| 560 | 0.036 21 | 3526.9 | 6.7885 | 0.032 70 | 3517.2 | 6.7356 | 0.029 78 | 3507.4 | 6.6864 | 560 |
| 570 | 0.036 76 | 3551.8 | 6.8182 | 0.033 21 | 3542.4 | 6.7657 | 0.030 26 | 3533.0 | 6.7169 | 570 |
| 580 | 0.037 30 | 3576.5 | 6.8474 | 0.033 71 | 3567.5 | 6.7953 | 0.030 72 | 3558.4 | 6.7469 | 580 |
| 590 | 0.037 84 | 3601.2 | 6.8761 | 0.034 21 | 3592.5 | 6.8244 | 0.031 19 | 3583.8 | 6.7764 | 590 |
| 600 | 0.038 38 | 3625.8 | 6.9045 | 0.034 71 | 3617.5 | 6.8531 | 0.031 65 | 3609.0 | 6.8055 | 600 |
| 610 | 0.038 91 | 3650.4 | 6.9325 | 0.035 20 | 3642.3 | 6.8814 | 0.032 11 | 3634.2 | 6.8341 | 610 |
| 620 | 0.039 44 | 3674.9 | 6.9601 | 0.035 69 | 3667.1 | 6.9094 | 0.032 56 | 3659.2 | 6.8624 | 620 |
| 630 | 0.039 97 | 3699.4 | 6.9874 | 0.036 18 | 3691.9 | 6.9369 | 0.033 02 | 3684.2 | 6.8902 | 630 |
| 640 | 0.040 49 | 3723.9 | 7.0143 | 0.036 66 | 3716.6 | 6.9641 | 0.033 46 | 3709.2 | 6.9177 | 640 |
| 650 | 0.041 02 | 3748.3 | 7.0409 | 0.037 14 | 3741.2 | 6.9910 | 0.033 91 | 3734.1 | 6.9448 | 650 |
| 660 | 0.041 54 | 3772.7 | 7.0672 | 0.037 62 | 3765.8 | 7.0175 | 0.034 35 | 3758.9 | 6.9716 | 660 |
| 670 | 0.042 05 | 3797.1 | 7.0932 | 0.038 09 | 3790.4 | 7.0437 | 0.034 80 | 3783.7 | 6.9980 | 670 |
| 680 | 0.042 57 | 3821.5 | 7.1189 | 0.038 57 | 3815.0 | 7.0696 | 0.035 23 | 3808.5 | 7.0241 | 680 |
| 690 | 0.043 08 | 3845.9 | 7.1444 | 0.039 04 | 3839.6 | 7.0953 | 0.035 67 | 3833.3 | 7.0500 | 690 |
| 700 | 0.043 59 | 3870.3 | 7.1696 | 0.039 51 | 3864.2 | 7.1207 | 0.036 11 | 3858.0 | 7.0756 | 700 |
| 710 | 0.044 10 | 3894.7 | 7.1945 | 0.039 98 | 3888.7 | 7.1458 | 0.036 54 | 3882.8 | 7.1008 | 710 |
| 720 | 0.044 61 | 3919.0 | 7.2192 | 0.040 44 | 3913.3 | 7.1706 | 0.036 97 | 3907.5 | 7.1259 | 720 |
| 730 | 0.045 12 | 3943.4 | 7.2436 | 0.040 91 | 3937.8 | 7.1952 | 0.037 40 | 3932.2 | 7.1506 | 730 |
| 740 | 0.045 62 | 3967.9 | 7.2678 | 0.041 37 | 3962.4 | 7.2196 | 0.037 83 | 3956.9 | 7.1751 | 740 |
| 750 | 0.046 13 | 3992.3 | 7.2918 | 0.041 83 | 3987.0 | 7.2437 | 0.038 26 | 3981.6 | 7.1994 | 750 |
| 760 | 0.046 63 | 4016.7 | 7.3156 | 0.042 29 | 4011.6 | 7.2676 | 0.038 68 | 4006.4 | 7.2235 | 760 |
| 770 | 0.047 13 | 4041.2 | 7.3392 | 0.042 75 | 4036.2 | 7.2913 | 0.039 11 | 4031.1 | 7.2473 | 770 |
| 780 | 0.047 63 | 4065.7 | 7.3625 | 0.043 21 | 4060.8 | 7.3148 | 0.039 53 | 4055.9 | 7.2709 | 780 |
| 790 | 0.048 13 | 4090.2 | 7.3857 | 0.043 67 | 4085.4 | 7.3381 | 0.039 95 | 4080.6 | 7.2943 | 790 |
| 800 | 0.048 62 | 4114.7 | 7.4086 | 0.044 12 | 4110.1 | 7.3612 | 0.040 37 | 4105.4 | 7.3175 | 800 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 13 MPa ($t_{sat}$ = 330.86 °C) | | | 14 MPa ($t_{sat}$ = 336.67 °C) | | | 15 MPa ($t_{sat}$ = 342.16 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 566 | 1531.4 | 3.5606 | 0.001 610 | 1570.9 | 3.6230 | 0.001 657 | 1610.2 | 3.6844 | Sat. Liq. |
| Sat. Vap. | 0.012 79 | 2662.9 | 5.4339 | 0.011 49 | 2638.1 | 5.3730 | 0.010 34 | 2610.9 | 5.3108 | Sat. Vap. |
| **0** | 0.000 993 7 | 13.07 | 0.0004 | 0.000 993 2 | 14.07 | 0.0004 | 0.000 992 8 | 15.07 | 0.0004 | **0** |
| **5** | 0.000 993 8 | 33.85 | 0.0758 | 0.000 993 3 | 34.83 | 0.0757 | 0.000 992 9 | 35.81 | 0.0757 | **5** |
| **10** | 0.000 994 3 | 54.60 | 0.1497 | 0.000 993 8 | 55.56 | 0.1496 | 0.000 993 3 | 56.52 | 0.1495 | **10** |
| **15** | 0.000 995 0 | 75.35 | 0.2224 | 0.000 994 5 | 76.29 | 0.2222 | 0.000 994 1 | 77.23 | 0.2220 | **15** |
| **20** | 0.000 996 0 | 96.08 | 0.2937 | 0.000 995 5 | 97.01 | 0.2935 | 0.000 995 1 | 97.94 | 0.2932 | **20** |
| **25** | 0.000 997 2 | 116.81 | 0.3638 | 0.000 996 8 | 117.73 | 0.3636 | 0.000 996 4 | 118.64 | 0.3633 | **25** |
| **30** | 0.000 998 7 | 137.54 | 0.4328 | 0.000 998 3 | 138.45 | 0.4325 | 0.000 997 8 | 139.35 | 0.4322 | **30** |
| **35** | 0.001 000 4 | 158.28 | 0.5006 | 0.000 999 9 | 159.17 | 0.5003 | 0.000 999 5 | 160.06 | 0.4999 | **35** |
| **40** | 0.001 002 2 | 179.02 | 0.5674 | 0.001 001 8 | 179.90 | 0.5670 | 0.001 001 4 | 180.78 | 0.5666 | **40** |
| **45** | 0.001 004 2 | 199.76 | 0.6331 | 0.001 003 8 | 200.63 | 0.6327 | 0.001 003 4 | 201.50 | 0.6322 | **45** |
| **50** | 0.001 006 5 | 220.51 | 0.6978 | 0.001 006 0 | 221.37 | 0.6973 | 0.001 005 6 | 222.23 | 0.6969 | **50** |
| **55** | 0.001 008 8 | 241.27 | 0.7616 | 0.001 008 4 | 242.12 | 0.7611 | 0.001 008 0 | 242.96 | 0.7606 | **55** |
| **60** | 0.001 011 4 | 262.04 | 0.8244 | 0.001 010 9 | 262.88 | 0.8238 | 0.001 010 5 | 263.71 | 0.8233 | **60** |
| **65** | 0.001 014 1 | 282.82 | 0.8863 | 0.001 013 6 | 283.65 | 0.8857 | 0.001 013 2 | 284.47 | 0.8852 | **65** |
| **70** | 0.001 016 9 | 303.62 | 0.9473 | 0.001 016 5 | 304.43 | 0.9468 | 0.001 016 0 | 305.25 | 0.9462 | **70** |
| **75** | 0.001 019 9 | 324.43 | 1.0075 | 0.001 019 5 | 325.24 | 1.0069 | 0.001 019 0 | 326.04 | 1.0063 | **75** |
| **80** | 0.001 023 0 | 345.26 | 1.0670 | 0.001 022 6 | 346.06 | 1.0663 | 0.001 022 1 | 346.85 | 1.0657 | **80** |
| **85** | 0.001 026 3 | 366.11 | 1.1256 | 0.001 025 9 | 366.90 | 1.1249 | 0.001 025 4 | 367.68 | 1.1242 | **85** |
| **90** | 0.001 029 7 | 386.99 | 1.1835 | 0.001 029 3 | 387.76 | 1.1828 | 0.001 028 8 | 388.54 | 1.1821 | **90** |
| **95** | 0.001 033 3 | 407.89 | 1.2406 | 0.001 032 8 | 408.65 | 1.2399 | 0.001 032 4 | 409.42 | 1.2392 | **95** |
| **100** | 0.001 037 0 | 428.81 | 1.2971 | 0.001 036 5 | 429.57 | 1.2963 | 0.001 036 1 | 430.32 | 1.2956 | **100** |
| **105** | 0.001 040 9 | 449.77 | 1.3529 | 0.001 040 4 | 450.51 | 1.3521 | 0.001 039 9 | 451.25 | 1.3513 | **105** |
| **110** | 0.001 044 9 | 470.75 | 1.4080 | 0.001 044 4 | 471.49 | 1.4072 | 0.001 043 9 | 472.22 | 1.4064 | **110** |
| **115** | 0.001 049 0 | 491.77 | 1.4625 | 0.001 048 5 | 492.49 | 1.4617 | 0.001 048 0 | 493.22 | 1.4608 | **115** |
| **120** | 0.001 053 3 | 512.83 | 1.5164 | 0.001 052 8 | 513.54 | 1.5155 | 0.001 052 3 | 514.25 | 1.5147 | **120** |
| **125** | 0.001 057 8 | 533.92 | 1.5697 | 0.001 057 2 | 534.62 | 1.5688 | 0.001 056 7 | 535.32 | 1.5679 | **125** |
| **130** | 0.001 062 3 | 555.06 | 1.6225 | 0.001 061 8 | 555.75 | 1.6215 | 0.001 061 2 | 556.43 | 1.6206 | **130** |
| **135** | 0.001 067 1 | 576.24 | 1.6747 | 0.001 066 5 | 576.91 | 1.6737 | 0.001 065 9 | 577.59 | 1.6728 | **135** |
| **140** | 0.001 072 0 | 597.47 | 1.7264 | 0.001 071 4 | 598.13 | 1.7254 | 0.001 070 8 | 598.79 | 1.7244 | **140** |
| **145** | 0.001 077 1 | 618.74 | 1.7776 | 0.001 076 5 | 619.39 | 1.7765 | 0.001 075 9 | 620.04 | 1.7755 | **145** |
| **150** | 0.001 082 3 | 640.07 | 1.8283 | 0.001 081 7 | 640.71 | 1.8272 | 0.001 081 0 | 641.34 | 1.8262 | **150** |
| **155** | 0.001 087 7 | 661.46 | 1.8785 | 0.001 087 1 | 662.08 | 1.8774 | 0.001 086 4 | 662.70 | 1.8763 | **155** |
| **160** | 0.001 093 3 | 682.91 | 1.9283 | 0.001 092 6 | 683.51 | 1.9272 | 0.001 092 0 | 684.12 | 1.9261 | **160** |
| **165** | 0.001 099 1 | 704.42 | 1.9777 | 0.001 098 4 | 705.01 | 1.9765 | 0.001 097 7 | 705.60 | 1.9754 | **165** |
| **170** | 0.001 105 0 | 726.00 | 2.0267 | 0.001 104 3 | 726.57 | 2.0255 | 0.001 103 6 | 727.14 | 2.0243 | **170** |
| **175** | 0.001 111 2 | 747.66 | 2.0753 | 0.001 110 5 | 748.21 | 2.0740 | 0.001 109 7 | 748.76 | 2.0728 | **175** |
| **180** | 0.001 117 6 | 769.39 | 2.1235 | 0.001 116 8 | 769.93 | 2.1222 | 0.001 116 0 | 770.46 | 2.1209 | **180** |
| **185** | 0.001 124 2 | 791.21 | 2.1714 | 0.001 123 3 | 791.72 | 2.1701 | 0.001 122 5 | 792.24 | 2.1687 | **185** |
| **190** | 0.001 131 0 | 813.12 | 2.2190 | 0.001 130 1 | 813.61 | 2.2176 | 0.001 129 3 | 814.10 | 2.2162 | **190** |
| **195** | 0.001 138 0 | 835.12 | 2.2662 | 0.001 137 2 | 835.59 | 2.2648 | 0.001 136 3 | 836.06 | 2.2634 | **195** |
| **200** | 0.001 145 3 | 857.23 | 2.3132 | 0.001 144 4 | 857.67 | 2.3117 | 0.001 143 5 | 858.12 | 2.3102 | **200** |
| **205** | 0.001 152 9 | 879.44 | 2.3599 | 0.001 151 9 | 879.86 | 2.3583 | 0.001 151 0 | 880.28 | 2.3568 | **205** |
| **210** | 0.001 160 8 | 901.78 | 2.4064 | 0.001 159 8 | 902.17 | 2.4048 | 0.001 158 7 | 902.56 | 2.4032 | **210** |
| **215** | 0.001 168 9 | 924.24 | 2.4526 | 0.001 167 9 | 924.60 | 2.4509 | 0.001 166 8 | 924.96 | 2.4493 | **215** |
| **220** | 0.001 177 4 | 946.83 | 2.4986 | 0.001 176 3 | 947.16 | 2.4969 | 0.001 175 1 | 947.49 | 2.4952 | **220** |
| **225** | 0.001 186 2 | 969.57 | 2.5445 | 0.001 185 0 | 969.86 | 2.5427 | 0.001 183 8 | 970.16 | 2.5410 | **225** |
| **230** | 0.001 195 4 | 992.47 | 2.5903 | 0.001 194 1 | 992.72 | 2.5884 | 0.001 192 9 | 992.99 | 2.5865 | **230** |
| **235** | 0.001 205 | 1015.5 | 2.6359 | 0.001 204 | 1015.7 | 2.6339 | 0.001 202 | 1016.0 | 2.6320 | **235** |
| **240** | 0.001 215 | 1038.8 | 2.6814 | 0.001 213 | 1039.0 | 2.6794 | 0.001 212 | 1039.1 | 2.6774 | **240** |
| **245** | 0.001 225 | 1062.2 | 2.7269 | 0.001 224 | 1062.3 | 2.7247 | 0.001 222 | 1062.5 | 2.7226 | **245** |
| **250** | 0.001 236 | 1085.9 | 2.7723 | 0.001 235 | 1086.0 | 2.7701 | 0.001 233 | 1086.0 | 2.7679 | **250** |
| **255** | 0.001 248 | 1109.8 | 2.8177 | 0.001 246 | 1109.8 | 2.8154 | 0.001 244 | 1109.8 | 2.8131 | **255** |
| **260** | 0.001 260 | 1133.9 | 2.8632 | 0.001 258 | 1133.9 | 2.8608 | 0.001 256 | 1133.8 | 2.8584 | **260** |
| **265** | 0.001 272 | 1158.3 | 2.9088 | 0.001 270 | 1158.2 | 2.9062 | 0.001 268 | 1158.1 | 2.9037 | **265** |
| **270** | 0.001 286 | 1183.0 | 2.9546 | 0.001 283 | 1182.9 | 2.9518 | 0.001 281 | 1182.7 | 2.9491 | **270** |

**UNITS**: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| $t$ (°C) | 13 MPa ($t_{sat}$ = 330.86 °C) | | | 14 MPa ($t_{sat}$ = 336.67 °C) | | | 15 MPa ($t_{sat}$ = 342.16 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| 275 | 0.001 300 | 1208.1 | 3.0005 | 0.001 297 | 1207.8 | 2.9976 | 0.001 295 | 1207.6 | 2.9947 | 275 |
| 280 | 0.001 315 | 1233.5 | 3.0466 | 0.001 312 | 1233.1 | 3.0436 | 0.001 310 | 1232.8 | 3.0406 | 280 |
| 285 | 0.001 331 | 1259.4 | 3.0931 | 0.001 328 | 1258.9 | 3.0899 | 0.001 325 | 1258.4 | 3.0867 | 285 |
| 290 | 0.001 348 | 1285.7 | 3.1401 | 0.001 345 | 1285.0 | 3.1366 | 0.001 342 | 1284.5 | 3.1331 | 290 |
| 295 | 0.001 366 | 1312.5 | 3.1875 | 0.001 363 | 1311.7 | 3.1837 | 0.001 359 | 1311.0 | 3.1800 | 295 |
| 300 | 0.001 386 | 1339.9 | 3.2355 | 0.001 382 | 1339.0 | 3.2315 | 0.001 378 | 1338.1 | 3.2275 | 300 |
| 310 | 0.001 431 | 1397.0 | 3.3342 | 0.001 426 | 1395.6 | 3.3293 | 0.001 421 | 1394.2 | 3.3246 | 310 |
| 320 | 0.001 487 | 1458.0 | 3.4380 | 0.001 480 | 1455.9 | 3.4319 | 0.001 473 | 1453.8 | 3.4260 | 320 |
| 330 | 0.001 559 | 1525.2 | 3.5503 | 0.001 549 | 1521.8 | 3.5421 | 0.001 539 | 1518.6 | 3.5343 | 330 |
| 340 | 0.014 03 | 2738.9 | 5.5589 | 0.012 00 | 2672.4 | 5.4291 | 0.001 631 | 1592.3 | 3.6553 | 340 |
| 350 | 0.015 12 | 2803.6 | 5.6635 | 0.013 23 | 2752.9 | 5.5595 | 0.011 48 | 2693.0 | 5.4435 | 350 |
| 360 | 0.016 05 | 2858.1 | 5.7503 | 0.014 23 | 2816.4 | 5.6605 | 0.012 58 | 2769.6 | 5.5654 | 360 |
| 370 | 0.016 89 | 2906.1 | 5.8255 | 0.015 09 | 2870.4 | 5.7452 | 0.013 49 | 2831.4 | 5.6624 | 370 |
| 380 | 0.017 65 | 2949.6 | 5.8927 | 0.015 87 | 2918.3 | 5.8190 | 0.014 29 | 2884.6 | 5.7445 | 380 |
| 390 | 0.018 36 | 2989.9 | 5.9539 | 0.016 58 | 2961.8 | 5.8853 | 0.015 01 | 2932.1 | 5.8166 | 390 |
| 400 | 0.019 03 | 3027.6 | 6.0104 | 0.017 24 | 3002.2 | 5.9457 | 0.015 67 | 2975.5 | 5.8817 | 400 |
| 410 | 0.019 67 | 3063.4 | 6.0631 | 0.017 87 | 3040.2 | 6.0017 | 0.016 29 | 3015.9 | 5.9412 | 410 |
| 420 | 0.020 28 | 3097.5 | 6.1127 | 0.018 46 | 3076.1 | 6.0539 | 0.016 88 | 3053.9 | 5.9965 | 420 |
| 430 | 0.020 86 | 3130.4 | 6.1598 | 0.019 03 | 3110.5 | 6.1032 | 0.017 43 | 3090.0 | 6.0482 | 430 |
| 440 | 0.021 43 | 3162.1 | 6.2046 | 0.019 58 | 3143.6 | 6.1499 | 0.017 96 | 3124.6 | 6.0970 | 440 |
| 450 | 0.021 98 | 3192.9 | 6.2475 | 0.020 10 | 3175.6 | 6.1945 | 0.018 48 | 3157.8 | 6.1433 | 450 |
| 460 | 0.022 51 | 3222.9 | 6.2887 | 0.020 62 | 3206.7 | 6.2371 | 0.018 97 | 3190.0 | 6.1875 | 460 |
| 470 | 0.023 03 | 3252.3 | 6.3285 | 0.021 12 | 3236.9 | 6.2782 | 0.019 46 | 3221.3 | 6.2298 | 470 |
| 480 | 0.023 54 | 3281.0 | 6.3669 | 0.021 60 | 3266.5 | 6.3177 | 0.019 92 | 3251.8 | 6.2706 | 480 |
| 490 | 0.024 04 | 3309.3 | 6.4042 | 0.022 08 | 3295.6 | 6.3560 | 0.020 38 | 3281.6 | 6.3099 | 490 |
| 500 | 0.024 52 | 3337.1 | 6.4404 | 0.022 55 | 3324.1 | 6.3931 | 0.020 83 | 3310.8 | 6.3479 | 500 |
| 510 | 0.025 01 | 3364.6 | 6.4757 | 0.023 00 | 3352.1 | 6.4292 | 0.021 27 | 3339.5 | 6.3848 | 510 |
| 520 | 0.025 48 | 3391.7 | 6.5101 | 0.023 45 | 3379.8 | 6.4643 | 0.021 70 | 3367.8 | 6.4207 | 520 |
| 530 | 0.025 94 | 3418.5 | 6.5437 | 0.023 90 | 3407.2 | 6.4986 | 0.022 12 | 3395.7 | 6.4556 | 530 |
| 540 | 0.026 41 | 3445.1 | 6.5765 | 0.024 33 | 3434.2 | 6.5320 | 0.022 54 | 3423.2 | 6.4897 | 540 |
| 550 | 0.026 86 | 3471.4 | 6.6087 | 0.024 76 | 3461.0 | 6.5648 | 0.022 95 | 3450.5 | 6.5230 | 550 |
| 560 | 0.027 31 | 3497.5 | 6.6403 | 0.025 19 | 3487.5 | 6.5968 | 0.023 35 | 3477.5 | 6.5556 | 560 |
| 570 | 0.027 75 | 3523.5 | 6.6713 | 0.025 61 | 3513.9 | 6.6283 | 0.023 75 | 3504.2 | 6.5875 | 570 |
| 580 | 0.028 19 | 3549.3 | 6.7017 | 0.026 02 | 3540.1 | 6.6591 | 0.024 14 | 3530.8 | 6.6188 | 580 |
| 590 | 0.028 63 | 3575.0 | 6.7316 | 0.026 44 | 3566.1 | 6.6894 | 0.024 53 | 3557.1 | 6.6496 | 590 |
| 600 | 0.029 06 | 3600.5 | 6.7610 | 0.026 84 | 3591.9 | 6.7192 | 0.024 92 | 3583.3 | 6.6797 | 600 |
| 610 | 0.029 49 | 3626.0 | 6.7900 | 0.027 25 | 3617.7 | 6.7486 | 0.025 30 | 3609.4 | 6.7094 | 610 |
| 620 | 0.029 92 | 3651.3 | 6.8185 | 0.027 65 | 3643.3 | 6.7774 | 0.025 68 | 3635.3 | 6.7386 | 620 |
| 630 | 0.030 34 | 3676.6 | 6.8467 | 0.028 05 | 3668.8 | 6.8058 | 0.026 06 | 3661.1 | 6.7673 | 630 |
| 640 | 0.030 76 | 3701.8 | 6.8744 | 0.028 44 | 3694.3 | 6.8339 | 0.026 43 | 3686.8 | 6.7956 | 640 |
| 650 | 0.031 18 | 3726.9 | 6.9018 | 0.028 83 | 3719.7 | 6.8615 | 0.026 80 | 3712.4 | 6.8235 | 650 |
| 660 | 0.031 59 | 3752.0 | 6.9288 | 0.029 22 | 3745.0 | 6.8888 | 0.027 17 | 3737.9 | 6.8510 | 660 |
| 670 | 0.032 00 | 3777.0 | 6.9555 | 0.029 61 | 3770.2 | 6.9157 | 0.027 54 | 3763.4 | 6.8782 | 670 |
| 680 | 0.032 41 | 3802.0 | 6.9818 | 0.030 00 | 3795.4 | 6.9422 | 0.027 90 | 3788.8 | 6.9050 | 680 |
| 690 | 0.032 82 | 3826.9 | 7.0079 | 0.030 38 | 3820.6 | 6.9685 | 0.028 26 | 3814.2 | 6.9314 | 690 |
| 700 | 0.033 23 | 3851.9 | 7.0336 | 0.030 76 | 3845.7 | 6.9944 | 0.028 62 | 3839.5 | 6.9576 | 700 |
| 710 | 0.033 63 | 3876.8 | 7.0591 | 0.031 14 | 3870.8 | 7.0201 | 0.028 98 | 3864.8 | 6.9834 | 710 |
| 720 | 0.034 03 | 3901.7 | 7.0843 | 0.031 51 | 3895.8 | 7.0455 | 0.029 33 | 3890.0 | 7.0090 | 720 |
| 730 | 0.034 43 | 3926.6 | 7.1092 | 0.031 89 | 3920.9 | 7.0705 | 0.029 68 | 3915.2 | 7.0342 | 730 |
| 740 | 0.034 83 | 3951.4 | 7.1339 | 0.032 26 | 3945.9 | 7.0954 | 0.030 04 | 3940.4 | 7.0592 | 740 |
| 750 | 0.035 23 | 3976.3 | 7.1583 | 0.032 64 | 3970.9 | 7.1200 | 0.030 39 | 3965.6 | 7.0839 | 750 |
| 760 | 0.035 63 | 4001.2 | 7.1825 | 0.033 01 | 3995.9 | 7.1443 | 0.030 74 | 3990.7 | 7.1084 | 760 |
| 770 | 0.036 02 | 4026.0 | 7.2065 | 0.033 38 | 4021.0 | 7.1684 | 0.031 08 | 4015.9 | 7.1326 | 770 |
| 780 | 0.036 41 | 4050.9 | 7.2302 | 0.033 74 | 4046.0 | 7.1922 | 0.031 43 | 4041.0 | 7.1566 | 780 |
| 790 | 0.036 81 | 4075.8 | 7.2537 | 0.034 11 | 4071.0 | 7.2159 | 0.031 77 | 4066.2 | 7.1804 | 790 |
| 800 | 0.037 20 | 4100.7 | 7.2771 | 0.034 48 | 4096.0 | 7.2393 | 0.032 12 | 4091.3 | 7.2039 | 800 |

UNITS: $v$ in $m^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 16 MPa ($t_{sat}$ = 347.36 °C) | | | 18 MPa ($t_{sat}$ = 356.99 °C) | | | 20 MPa ($t_{sat}$ = 365.75 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.001 710 | 1649.7 | 3.7457 | 0.001 839 | 1732.0 | 3.8717 | 0.002 039 | 1827.1 | 4.0154 | Sat. Liq. |
| Sat. Vap. | 0.009 308 | 2580.8 | 5.2463 | 0.007 499 | 2509.5 | 5.1055 | 0.005 858 | 2411.4 | 4.9299 | Sat. Vap. |
| **0** | 0.000 992 3 | 16.07 | 0.0005 | 0.000 991 3 | 18.05 | 0.0005 | 0.000 990 4 | 20.03 | 0.0005 | **0** |
| **5** | 0.000 992 4 | 36.78 | 0.0756 | 0.000 991 5 | 38.73 | 0.0755 | 0.000 990 6 | 40.67 | 0.0753 | **5** |
| **10** | 0.000 992 9 | 57.48 | 0.1494 | 0.000 992 0 | 59.40 | 0.1491 | 0.000 991 1 | 61.30 | 0.1489 | **10** |
| **15** | 0.000 993 6 | 78.18 | 0.2218 | 0.000 992 8 | 80.06 | 0.2215 | 0.000 991 9 | 81.94 | 0.2211 | **15** |
| **20** | 0.000 994 7 | 98.87 | 0.2930 | 0.000 993 8 | 100.72 | 0.2926 | 0.000 992 9 | 102.57 | 0.2921 | **20** |
| **25** | 0.000 995 9 | 119.56 | 0.3630 | 0.000 995 1 | 121.39 | 0.3625 | 0.000 994 2 | 123.21 | 0.3619 | **25** |
| **30** | 0.000 997 4 | 140.25 | 0.4318 | 0.000 996 5 | 142.06 | 0.4312 | 0.000 995 7 | 143.86 | 0.4306 | **30** |
| **35** | 0.000 999 1 | 160.95 | 0.4996 | 0.000 998 2 | 162.73 | 0.4989 | 0.000 997 4 | 164.51 | 0.4981 | **35** |
| **40** | 0.001 000 9 | 181.66 | 0.5662 | 0.001 000 1 | 183.41 | 0.5654 | 0.000 999 2 | 185.17 | 0.5646 | **40** |
| **45** | 0.001 003 0 | 202.37 | 0.6318 | 0.001 002 1 | 204.10 | 0.6310 | 0.001 001 3 | 205.83 | 0.6301 | **45** |
| **50** | 0.001 005 2 | 223.08 | 0.6964 | 0.001 004 3 | 224.80 | 0.6955 | 0.001 003 5 | 226.51 | 0.6946 | **50** |
| **55** | 0.001 007 5 | 243.81 | 0.7601 | 0.001 006 7 | 245.50 | 0.7591 | 0.001 005 8 | 247.19 | 0.7581 | **55** |
| **60** | 0.001 010 1 | 264.55 | 0.8228 | 0.001 009 2 | 266.22 | 0.8218 | 0.001 008 4 | 267.89 | 0.8207 | **60** |
| **65** | 0.001 012 8 | 285.30 | 0.8846 | 0.001 011 9 | 286.95 | 0.8835 | 0.001 011 0 | 288.60 | 0.8824 | **65** |
| **70** | 0.001 015 6 | 306.07 | 0.9456 | 0.001 014 7 | 307.70 | 0.9444 | 0.001 013 8 | 309.33 | 0.9433 | **70** |
| **75** | 0.001 018 6 | 326.85 | 1.0057 | 0.001 017 7 | 328.46 | 1.0045 | 0.001 016 8 | 330.07 | 1.0033 | **75** |
| **80** | 0.001 021 7 | 347.65 | 1.0650 | 0.001 020 8 | 349.24 | 1.0638 | 0.001 019 9 | 350.83 | 1.0625 | **80** |
| **85** | 0.001 024 9 | 368.47 | 1.1236 | 0.001 024 0 | 370.04 | 1.1223 | 0.001 023 1 | 371.62 | 1.1209 | **85** |
| **90** | 0.001 028 3 | 389.31 | 1.1814 | 0.001 027 4 | 390.87 | 1.1800 | 0.001 026 5 | 392.42 | 1.1786 | **90** |
| **95** | 0.001 031 9 | 410.18 | 1.2384 | 0.001 031 0 | 411.71 | 1.2370 | 0.001 030 0 | 413.25 | 1.2356 | **95** |
| **100** | 0.001 035 6 | 431.08 | 1.2948 | 0.001 034 6 | 432.59 | 1.2933 | 0.001 033 7 | 434.10 | 1.2918 | **100** |
| **105** | 0.001 039 4 | 452.00 | 1.3505 | 0.001 038 4 | 453.49 | 1.3490 | 0.001 037 4 | 454.98 | 1.3474 | **105** |
| **110** | 0.001 043 4 | 472.95 | 1.4056 | 0.001 042 4 | 474.42 | 1.4040 | 0.001 041 4 | 475.89 | 1.4024 | **110** |
| **115** | 0.001 047 5 | 493.94 | 1.4600 | 0.001 046 4 | 495.39 | 1.4583 | 0.001 045 4 | 496.83 | 1.4567 | **115** |
| **120** | 0.001 051 7 | 514.96 | 1.5138 | 0.001 050 7 | 516.39 | 1.5121 | 0.001 049 6 | 517.81 | 1.5104 | **120** |
| **125** | 0.001 056 1 | 536.02 | 1.5670 | 0.001 055 0 | 537.42 | 1.5652 | 0.001 054 0 | 538.82 | 1.5635 | **125** |
| **130** | 0.001 060 7 | 557.12 | 1.6197 | 0.001 059 6 | 558.50 | 1.6178 | 0.001 058 5 | 559.88 | 1.6160 | **130** |
| **135** | 0.001 065 4 | 578.26 | 1.6718 | 0.001 064 2 | 579.61 | 1.6699 | 0.001 063 1 | 580.97 | 1.6680 | **135** |
| **140** | 0.001 070 2 | 599.45 | 1.7234 | 0.001 069 1 | 600.78 | 1.7214 | 0.001 067 9 | 602.11 | 1.7195 | **140** |
| **145** | 0.001 075 2 | 620.69 | 1.7745 | 0.001 074 0 | 621.99 | 1.7725 | 0.001 072 8 | 623.29 | 1.7705 | **145** |
| **150** | 0.001 080 4 | 641.97 | 1.8251 | 0.001 079 2 | 643.25 | 1.8230 | 0.001 077 9 | 644.52 | 1.8209 | **150** |
| **155** | 0.001 085 8 | 663.32 | 1.8753 | 0.001 084 5 | 664.56 | 1.8731 | 0.001 083 2 | 665.81 | 1.8709 | **155** |
| **160** | 0.001 091 3 | 684.72 | 1.9250 | 0.001 090 0 | 685.93 | 1.9227 | 0.001 088 6 | 687.15 | 1.9205 | **160** |
| **165** | 0.001 097 0 | 706.18 | 1.9742 | 0.001 095 6 | 707.37 | 1.9719 | 0.001 094 3 | 708.55 | 1.9696 | **165** |
| **170** | 0.001 102 9 | 727.72 | 2.0231 | 0.001 101 5 | 728.86 | 2.0207 | 0.001 100 0 | 730.02 | 2.0183 | **170** |
| **175** | 0.001 109 0 | 749.32 | 2.0716 | 0.001 107 5 | 750.43 | 2.0691 | 0.001 106 0 | 751.55 | 2.0667 | **175** |
| **180** | 0.001 115 2 | 770.99 | 2.1197 | 0.001 113 7 | 772.07 | 2.1171 | 0.001 112 2 | 773.16 | 2.1146 | **180** |
| **185** | 0.001 121 7 | 792.75 | 2.1674 | 0.001 120 1 | 793.79 | 2.1648 | 0.001 118 6 | 794.84 | 2.1622 | **185** |
| **190** | 0.001 128 4 | 814.60 | 2.2148 | 0.001 126 8 | 815.59 | 2.2121 | 0.001 125 1 | 816.60 | 2.2094 | **190** |
| **195** | 0.001 135 4 | 836.53 | 2.2619 | 0.001 133 7 | 837.49 | 2.2591 | 0.001 132 0 | 838.45 | 2.2563 | **195** |
| **200** | 0.001 142 6 | 858.57 | 2.3088 | 0.001 140 8 | 859.47 | 2.3058 | 0.001 139 0 | 860.39 | 2.3030 | **200** |
| **205** | 0.001 150 0 | 880.71 | 2.3553 | 0.001 148 1 | 881.56 | 2.3523 | 0.001 146 3 | 882.43 | 2.3493 | **205** |
| **210** | 0.001 157 7 | 902.96 | 2.4016 | 0.001 155 8 | 903.76 | 2.3985 | 0.001 153 8 | 904.58 | 2.3954 | **210** |
| **215** | 0.001 165 7 | 925.33 | 2.4477 | 0.001 163 7 | 926.08 | 2.4444 | 0.001 161 6 | 926.84 | 2.4412 | **215** |
| **220** | 0.001 174 0 | 947.83 | 2.4935 | 0.001 171 8 | 948.52 | 2.4902 | 0.001 169 7 | 949.22 | 2.4868 | **220** |
| **225** | 0.001 182 7 | 970.47 | 2.5392 | 0.001 180 4 | 971.09 | 2.5357 | 0.001 178 1 | 971.73 | 2.5323 | **225** |
| **230** | 0.001 191 6 | 993.25 | 2.5847 | 0.001 189 2 | 993.81 | 2.5811 | 0.001 186 8 | 994.38 | 2.5775 | **230** |
| **235** | 0.001 201 | 1016.2 | 2.6301 | 0.001 198 4 | 1016.7 | 2.6263 | 0.001 195 9 | 1017.2 | 2.6226 | **235** |
| **240** | 0.001 211 | 1039.3 | 2.6754 | 0.001 208 | 1039.7 | 2.6714 | 0.001 205 | 1040.1 | 2.6675 | **240** |
| **245** | 0.001 221 | 1062.6 | 2.7206 | 0.001 218 | 1062.9 | 2.7164 | 0.001 215 | 1063.3 | 2.7124 | **245** |
| **250** | 0.001 231 | 1086.1 | 2.7657 | 0.001 228 | 1086.3 | 2.7614 | 0.001 225 | 1086.6 | 2.7572 | **250** |
| **255** | 0.001 243 | 1109.8 | 2.8108 | 0.001 239 | 1110.0 | 2.8063 | 0.001 236 | 1110.1 | 2.8019 | **255** |
| **260** | 0.001 254 | 1133.8 | 2.8560 | 0.001 251 | 1133.8 | 2.8513 | 0.001 247 | 1133.8 | 2.8466 | **260** |
| **265** | 0.001 266 | 1158.0 | 2.9012 | 0.001 263 | 1157.9 | 2.8962 | 0.001 259 | 1157.8 | 2.8914 | **265** |
| **270** | 0.001 279 | 1182.5 | 2.9465 | 0.001 275 | 1182.2 | 2.9413 | 0.001 271 | 1182.0 | 2.9362 | **270** |

**UNITS**: $v$ in $m^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 16 MPa ($t_{sat}$ = 347.36 °C) | | | 18 MPa ($t_{sat}$ = 356.99 °C) | | | 20 MPa ($t_{sat}$ = 365.75 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 0.001 293 | 1207.3 | 2.9919 | 0.001 288 | 1206.9 | 2.9864 | 0.001 284 | 1206.5 | 2.9810 | 275 |
| 280 | 0.001 307 | 1232.5 | 3.0376 | 0.001 302 | 1231.8 | 3.0317 | 0.001 298 | 1231.3 | 3.0261 | 280 |
| 285 | 0.001 322 | 1258.0 | 3.0835 | 0.001 317 | 1257.1 | 3.0773 | 0.001 312 | 1256.4 | 3.0713 | 285 |
| 290 | 0.001 339 | 1283.9 | 3.1297 | 0.001 333 | 1282.8 | 3.1231 | 0.001 328 | 1281.9 | 3.1167 | 290 |
| 295 | 0.001 356 | 1310.3 | 3.1764 | 0.001 350 | 1309.0 | 3.1693 | 0.001 344 | 1307.8 | 3.1625 | 295 |
| 300 | 0.001 375 | 1337.2 | 3.2236 | 0.001 368 | 1335.6 | 3.2160 | 0.001 361 | 1334.1 | 3.2087 | 300 |
| 310 | 0.001 417 | 1392.9 | 3.3200 | 0.001 408 | 1390.6 | 3.3110 | 0.001 400 | 1388.4 | 3.3025 | 310 |
| 320 | 0.001 467 | 1451.9 | 3.4203 | 0.001 456 | 1448.4 | 3.4095 | 0.001 445 | 1445.3 | 3.3993 | 320 |
| 330 | 0.001 530 | 1515.7 | 3.5269 | 0.001 514 | 1510.4 | 3.5131 | 0.001 500 | 1505.8 | 3.5004 | 330 |
| 340 | 0.001 616 | 1587.3 | 3.6445 | 0.001 591 | 1578.7 | 3.6253 | 0.001 569 | 1571.5 | 3.6085 | 340 |
| 350 | 0.009 766 | 2617.0 | 5.3045 | 0.001 703 | 1658.7 | 3.7546 | 0.001 665 | 1646.0 | 3.7288 | 350 |
| 360 | 0.011 06 | 2715.6 | 5.4616 | 0.008 110 | 2566.0 | 5.1950 | 0.001 825 | 1740.1 | 3.8787 | 360 |
| 370 | 0.012 05 | 2788.3 | 5.5755 | 0.009 451 | 2683.7 | 5.3795 | 0.006 924 | 2526.5 | 5.1095 | 370 |
| 380 | 0.012 88 | 2848.3 | 5.6680 | 0.010 42 | 2764.9 | 5.5048 | 0.008 258 | 2659.2 | 5.3144 | 380 |
| 390 | 0.013 61 | 2900.5 | 5.7474 | 0.011 22 | 2830.2 | 5.6041 | 0.009 190 | 2747.2 | 5.4482 | 390 |
| 400 | 0.014 28 | 2947.5 | 5.8177 | 0.011 91 | 2886.3 | 5.6881 | 0.009 950 | 2816.8 | 5.5525 | 400 |
| 410 | 0.014 90 | 2990.6 | 5.8814 | 0.012 54 | 2936.3 | 5.7618 | 0.010 61 | 2876.1 | 5.6398 | 410 |
| 420 | 0.015 48 | 3030.9 | 5.9399 | 0.013 12 | 2981.9 | 5.8281 | 0.011 20 | 2928.5 | 5.7160 | 420 |
| 430 | 0.016 03 | 3068.9 | 5.9943 | 0.013 66 | 3024.2 | 5.8887 | 0.011 74 | 2976.2 | 5.7843 | 430 |
| 440 | 0.016 55 | 3105.0 | 6.0453 | 0.014 17 | 3064.0 | 5.9448 | 0.012 25 | 3020.3 | 5.8466 | 440 |
| 450 | 0.017 05 | 3139.6 | 6.0935 | 0.014 65 | 3101.7 | 5.9973 | 0.012 72 | 3061.5 | 5.9041 | 450 |
| 460 | 0.017 53 | 3173.0 | 6.1393 | 0.015 12 | 3137.7 | 6.0468 | 0.013 17 | 3100.6 | 5.9577 | 460 |
| 470 | 0.018 00 | 3205.3 | 6.1831 | 0.015 56 | 3172.3 | 6.0936 | 0.013 60 | 3137.8 | 6.0081 | 470 |
| 480 | 0.018 45 | 3236.7 | 6.2251 | 0.015 99 | 3205.7 | 6.1383 | 0.014 01 | 3173.4 | 6.0558 | 480 |
| 490 | 0.018 89 | 3267.3 | 6.2655 | 0.016 41 | 3238.1 | 6.1811 | 0.014 41 | 3207.9 | 6.1012 | 490 |
| 500 | 0.019 32 | 3297.3 | 6.3045 | 0.016 81 | 3269.7 | 6.2222 | 0.014 79 | 3241.2 | 6.1445 | 500 |
| 510 | 0.019 74 | 3326.7 | 6.3423 | 0.017 20 | 3300.5 | 6.2618 | 0.015 17 | 3273.6 | 6.1862 | 510 |
| 520 | 0.020 16 | 3355.6 | 6.3790 | 0.017 59 | 3330.7 | 6.3002 | 0.015 53 | 3305.2 | 6.2263 | 520 |
| 530 | 0.020 56 | 3384.1 | 6.4146 | 0.017 97 | 3360.4 | 6.3373 | 0.015 88 | 3336.1 | 6.2650 | 530 |
| 540 | 0.020 96 | 3412.1 | 6.4494 | 0.018 33 | 3389.5 | 6.3734 | 0.016 23 | 3366.4 | 6.3026 | 540 |
| 550 | 0.021 35 | 3439.8 | 6.4832 | 0.018 70 | 3418.3 | 6.4085 | 0.016 57 | 3396.2 | 6.3390 | 550 |
| 560 | 0.021 74 | 3467.3 | 6.5164 | 0.019 05 | 3446.6 | 6.4427 | 0.016 90 | 3425.6 | 6.3744 | 560 |
| 570 | 0.022 12 | 3494.4 | 6.5488 | 0.019 41 | 3474.6 | 6.4762 | 0.017 23 | 3454.5 | 6.4089 | 570 |
| 580 | 0.022 50 | 3521.4 | 6.5805 | 0.019 75 | 3502.4 | 6.5089 | 0.017 55 | 3483.0 | 6.4426 | 580 |
| 590 | 0.022 87 | 3548.1 | 6.6117 | 0.020 09 | 3529.8 | 6.5408 | 0.017 87 | 3511.3 | 6.4755 | 590 |
| 600 | 0.023 24 | 3574.6 | 6.6422 | 0.020 43 | 3557.0 | 6.5722 | 0.018 18 | 3539.2 | 6.5077 | 600 |
| 610 | 0.023 60 | 3601.0 | 6.6722 | 0.020 76 | 3584.1 | 6.6030 | 0.018 49 | 3566.9 | 6.5392 | 610 |
| 620 | 0.023 96 | 3627.2 | 6.7018 | 0.021 09 | 3610.9 | 6.6332 | 0.018 80 | 3594.4 | 6.5701 | 620 |
| 630 | 0.024 32 | 3653.3 | 6.7308 | 0.021 42 | 3637.5 | 6.6629 | 0.019 10 | 3621.6 | 6.6005 | 630 |
| 640 | 0.024 67 | 3679.2 | 6.7594 | 0.021 74 | 3664.0 | 6.6920 | 0.019 40 | 3648.7 | 6.6303 | 640 |
| 650 | 0.025 03 | 3705.1 | 6.7876 | 0.022 06 | 3690.4 | 6.7208 | 0.019 69 | 3675.6 | 6.6596 | 650 |
| 660 | 0.025 37 | 3730.9 | 6.8153 | 0.022 38 | 3716.7 | 6.7491 | 0.019 99 | 3702.3 | 6.6884 | 660 |
| 670 | 0.025 72 | 3756.6 | 6.8427 | 0.022 70 | 3742.8 | 6.7769 | 0.020 28 | 3729.0 | 6.7168 | 670 |
| 680 | 0.026 07 | 3782.2 | 6.8697 | 0.023 01 | 3768.9 | 6.8044 | 0.020 56 | 3755.5 | 6.7447 | 680 |
| 690 | 0.026 41 | 3807.8 | 6.8964 | 0.023 32 | 3794.8 | 6.8315 | 0.020 85 | 3781.9 | 6.7723 | 690 |
| 700 | 0.026 75 | 3833.3 | 6.9228 | 0.023 63 | 3820.7 | 6.8583 | 0.021 13 | 3808.2 | 6.7994 | 700 |
| 710 | 0.027 09 | 3858.7 | 6.9488 | 0.023 93 | 3846.6 | 6.8847 | 0.021 41 | 3834.4 | 6.8262 | 710 |
| 720 | 0.027 42 | 3884.1 | 6.9745 | 0.024 24 | 3872.3 | 6.9107 | 0.021 69 | 3860.5 | 6.8527 | 720 |
| 730 | 0.027 76 | 3909.5 | 6.9999 | 0.024 54 | 3898.1 | 6.9365 | 0.021 97 | 3886.6 | 6.8788 | 730 |
| 740 | 0.028 09 | 3934.9 | 7.0251 | 0.024 84 | 3923.7 | 6.9620 | 0.022 25 | 3912.6 | 6.9046 | 740 |
| 750 | 0.028 42 | 3960.2 | 7.0499 | 0.025 14 | 3949.4 | 6.9872 | 0.022 52 | 3938.5 | 6.9301 | 750 |
| 760 | 0.028 75 | 3985.5 | 7.0746 | 0.025 44 | 3975.0 | 7.0121 | 0.022 79 | 3964.4 | 6.9553 | 760 |
| 770 | 0.029 08 | 4010.8 | 7.0989 | 0.025 74 | 4000.6 | 7.0367 | 0.023 06 | 3990.3 | 6.9802 | 770 |
| 780 | 0.029 41 | 4036.1 | 7.1231 | 0.026 03 | 4026.1 | 7.0611 | 0.023 33 | 4016.1 | 7.0048 | 780 |
| 790 | 0.029 73 | 4061.3 | 7.1469 | 0.026 33 | 4051.7 | 7.0852 | 0.023 60 | 4041.9 | 7.0292 | 790 |
| 800 | 0.030 06 | 4086.6 | 7.1706 | 0.026 62 | 4077.2 | 7.1091 | 0.023 87 | 4067.7 | 7.0534 | 800 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 22 MPa ($t_{sat}$ = 373.71 °C) | | | 24 MPa | | | 26 MPa | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Liq. | 0.002 750 | 2021.9 | 4.3109 | | | | | | | Sat. Liq. |
| Sat. Vap. | 0.003 577 | 2164.2 | 4.5308 | | | | | | | Sat. Vap. |
| **0** | 0.000 989 4 | 22.01 | 0.0005 | 0.000 988 5 | 23.98 | 0.0004 | 0.000 987 5 | 25.95 | 0.0004 | **0** |
| **5** | 0.000 989 6 | 42.61 | 0.0752 | 0.000 988 7 | 44.54 | 0.0750 | 0.000 987 8 | 46.47 | 0.0749 | **5** |
| **10** | 0.000 990 2 | 63.21 | 0.1486 | 0.000 989 3 | 65.11 | 0.1483 | 0.000 988 4 | 67.01 | 0.1480 | **10** |
| **15** | 0.000 991 0 | 83.81 | 0.2207 | 0.000 990 1 | 85.68 | 0.2203 | 0.000 989 3 | 87.55 | 0.2199 | **15** |
| **20** | 0.000 992 1 | 104.42 | 0.2916 | 0.000 991 2 | 106.26 | 0.2911 | 0.000 990 3 | 108.10 | 0.2907 | **20** |
| **25** | 0.000 993 3 | 125.03 | 0.3613 | 0.000 992 5 | 126.85 | 0.3608 | 0.000 991 7 | 128.67 | 0.3602 | **25** |
| **30** | 0.000 994 8 | 145.65 | 0.4299 | 0.000 994 0 | 147.45 | 0.4293 | 0.000 993 2 | 149.24 | 0.4287 | **30** |
| **35** | 0.000 996 5 | 166.28 | 0.4974 | 0.000 995 7 | 168.05 | 0.4967 | 0.000 994 9 | 169.83 | 0.4960 | **35** |
| **40** | 0.000 998 4 | 186.92 | 0.5639 | 0.000 997 6 | 188.67 | 0.5631 | 0.000 996 7 | 190.42 | 0.5623 | **40** |
| **45** | 0.001 000 4 | 207.56 | 0.6293 | 0.000 999 6 | 209.29 | 0.6284 | 0.000 998 8 | 211.02 | 0.6276 | **45** |
| **50** | 0.001 002 6 | 228.22 | 0.6937 | 0.001 001 8 | 229.93 | 0.6928 | 0.001 001 0 | 231.64 | 0.6919 | **50** |
| **55** | 0.001 005 0 | 248.89 | 0.7571 | 0.001 004 2 | 250.57 | 0.7562 | 0.001 003 3 | 252.26 | 0.7552 | **55** |
| **60** | 0.001 007 5 | 269.56 | 0.8197 | 0.001 006 7 | 271.23 | 0.8187 | 0.001 005 8 | 272.90 | 0.8176 | **60** |
| **65** | 0.001 010 2 | 290.25 | 0.8813 | 0.001 009 3 | 291.91 | 0.8802 | 0.001 008 5 | 293.56 | 0.8792 | **65** |
| **70** | 0.001 013 0 | 310.96 | 0.9421 | 0.001 012 1 | 312.59 | 0.9410 | 0.001 011 3 | 314.22 | 0.9398 | **70** |
| **75** | 0.001 015 9 | 331.68 | 1.0021 | 0.001 015 1 | 333.30 | 1.0009 | 0.001 014 2 | 334.91 | 0.9997 | **75** |
| **80** | 0.001 019 0 | 352.43 | 1.0612 | 0.001 018 1 | 354.02 | 1.0600 | 0.001 017 3 | 355.61 | 1.0587 | **80** |
| **85** | 0.001 022 2 | 373.19 | 1.1196 | 0.001 021 3 | 374.76 | 1.1183 | 0.001 020 5 | 376.34 | 1.1170 | **85** |
| **90** | 0.001 025 6 | 393.97 | 1.1772 | 0.001 024 7 | 395.53 | 1.1759 | 0.001 023 8 | 397.08 | 1.1745 | **90** |
| **95** | 0.001 029 1 | 414.78 | 1.2341 | 0.001 028 2 | 416.31 | 1.2327 | 0.001 027 2 | 417.85 | 1.2313 | **95** |
| **100** | 0.001 032 7 | 435.61 | 1.2904 | 0.001 031 8 | 437.13 | 1.2889 | 0.001 030 8 | 438.64 | 1.2874 | **100** |
| **105** | 0.001 036 5 | 456.47 | 1.3459 | 0.001 035 5 | 457.97 | 1.3444 | 0.001 034 6 | 459.46 | 1.3428 | **105** |
| **110** | 0.001 040 4 | 477.36 | 1.4008 | 0.001 039 4 | 478.84 | 1.3992 | 0.001 038 4 | 480.31 | 1.3976 | **110** |
| **115** | 0.001 044 4 | 498.28 | 1.4550 | 0.001 043 4 | 499.74 | 1.4534 | 0.001 042 4 | 501.19 | 1.4517 | **115** |
| **120** | 0.001 048 6 | 519.24 | 1.5087 | 0.001 047 6 | 520.67 | 1.5070 | 0.001 046 6 | 522.10 | 1.5053 | **120** |
| **125** | 0.001 052 9 | 540.23 | 1.5617 | 0.001 051 9 | 541.64 | 1.5600 | 0.001 050 8 | 543.05 | 1.5582 | **125** |
| **130** | 0.001 057 4 | 561.26 | 1.6142 | 0.001 056 3 | 562.64 | 1.6124 | 0.001 055 2 | 564.03 | 1.6106 | **130** |
| **135** | 0.001 062 0 | 582.33 | 1.6661 | 0.001 060 9 | 583.69 | 1.6643 | 0.001 059 8 | 585.05 | 1.6624 | **135** |
| **140** | 0.001 066 8 | 603.44 | 1.7175 | 0.001 065 6 | 604.78 | 1.7156 | 0.001 064 5 | 606.12 | 1.7137 | **140** |
| **145** | 0.001 071 7 | 624.60 | 1.7685 | 0.001 070 5 | 625.91 | 1.7665 | 0.001 069 3 | 627.22 | 1.7645 | **145** |
| **150** | 0.001 076 7 | 645.80 | 1.8189 | 0.001 075 5 | 647.09 | 1.8168 | 0.001 074 3 | 648.38 | 1.8148 | **150** |
| **155** | 0.001 082 0 | 667.06 | 1.8688 | 0.001 080 7 | 668.32 | 1.8667 | 0.001 079 5 | 669.58 | 1.8646 | **155** |
| **160** | 0.001 087 4 | 688.37 | 1.9183 | 0.001 086 1 | 689.60 | 1.9161 | 0.001 084 8 | 690.84 | 1.9140 | **160** |
| **165** | 0.001 092 9 | 709.75 | 1.9674 | 0.001 091 6 | 710.94 | 1.9651 | 0.001 090 3 | 712.15 | 1.9629 | **165** |
| **170** | 0.001 098 7 | 731.18 | 2.0160 | 0.001 097 3 | 732.35 | 2.0137 | 0.001 095 9 | 733.52 | 2.0114 | **170** |
| **175** | 0.001 105 | 752.68 | 2.0642 | 0.001 103 | 753.81 | 2.0618 | 0.001 102 | 754.95 | 2.0595 | **175** |
| **180** | 0.001 111 | 774.25 | 2.1121 | 0.001 109 | 775.35 | 2.1096 | 0.001 108 | 776.45 | 2.1072 | **180** |
| **185** | 0.001 117 | 795.89 | 2.1596 | 0.001 115 | 796.95 | 2.1570 | 0.001 114 | 798.02 | 2.1545 | **185** |
| **190** | 0.001 124 | 817.61 | 2.2068 | 0.001 122 | 818.64 | 2.2041 | 0.001 120 | 819.67 | 2.2015 | **190** |
| **195** | 0.001 130 | 839.42 | 2.2536 | 0.001 129 | 840.41 | 2.2509 | 0.001 127 | 841.40 | 2.2482 | **195** |
| **200** | 0.001 137 | 861.32 | 2.3001 | 0.001 135 | 862.26 | 2.2973 | 0.001 134 | 863.21 | 2.2945 | **200** |
| **205** | 0.001 144 | 883.31 | 2.3464 | 0.001 143 | 884.21 | 2.3434 | 0.001 141 | 885.11 | 2.3406 | **205** |
| **210** | 0.001 152 | 905.41 | 2.3923 | 0.001 150 | 906.26 | 2.3893 | 0.001 148 | 907.12 | 2.3863 | **210** |
| **215** | 0.001 160 | 927.62 | 2.4381 | 0.001 158 | 928.41 | 2.4349 | 0.001 156 | 929.22 | 2.4319 | **215** |
| **220** | 0.001 168 | 949.94 | 2.4836 | 0.001 166 | 950.68 | 2.4803 | 0.001 163 | 951.44 | 2.4771 | **220** |
| **225** | 0.001 176 | 972.39 | 2.5289 | 0.001 174 | 973.07 | 2.5255 | 0.001 172 | 973.77 | 2.5222 | **225** |
| **230** | 0.001 184 | 994.98 | 2.5740 | 0.001 182 | 995.59 | 2.5705 | 0.001 180 | 996.23 | 2.5671 | **230** |
| **235** | 0.001 193 | 1017.7 | 2.6189 | 0.001 191 | 1018.3 | 2.6153 | 0.001 189 | 1018.8 | 2.6117 | **235** |
| **240** | 0.001 203 | 1040.6 | 2.6637 | 0.001 200 | 1041.1 | 2.6600 | 0.001 198 | 1041.6 | 2.6563 | **240** |
| **245** | 0.001 212 | 1063.6 | 2.7084 | 0.001 210 | 1064.0 | 2.7045 | 0.001 207 | 1064.4 | 2.7007 | **245** |
| **250** | 0.001 222 | 1086.9 | 2.7530 | 0.001 220 | 1087.2 | 2.7490 | 0.001 217 | 1087.5 | 2.7449 | **250** |
| **255** | 0.001 233 | 1110.3 | 2.7976 | 0.001 230 | 1110.5 | 2.7933 | 0.001 227 | 1110.7 | 2.7891 | **255** |
| **260** | 0.001 244 | 1133.9 | 2.8421 | 0.001 241 | 1134.0 | 2.8376 | 0.001 237 | 1134.2 | 2.8333 | **260** |
| **265** | 0.001 255 | 1157.7 | 2.8866 | 0.001 252 | 1157.7 | 2.8820 | 0.001 249 | 1157.8 | 2.8774 | **265** |
| **270** | 0.001 267 | 1181.8 | 2.9312 | 0.001 264 | 1181.7 | 2.9263 | 0.001 260 | 1181.6 | 2.9215 | **270** |

**UNITS**: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 22 MPa ($t_{sat}$ = 373.71 °C) | | | 24 MPa | | | 26 MPa | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| 275 | 0.001 280 | 1206.2 | 2.9758 | 0.001 276 | 1205.9 | 2.9707 | 0.001 272 | 1205.7 | 2.9657 | 275 |
| 280 | 0.001 293 | 1230.8 | 3.0205 | 0.001 289 | 1230.4 | 3.0151 | 0.001 285 | 1230.1 | 3.0099 | 280 |
| 285 | 0.001 307 | 1255.8 | 3.0654 | 0.001 303 | 1255.2 | 3.0597 | 0.001 298 | 1254.7 | 3.0542 | 285 |
| 290 | 0.001 322 | 1281.1 | 3.1105 | 0.001 317 | 1280.3 | 3.1045 | 0.001 312 | 1279.6 | 3.0987 | 290 |
| 295 | 0.001 338 | 1306.7 | 3.1559 | 0.001 333 | 1305.8 | 3.1495 | 0.001 327 | 1304.9 | 3.1433 | 295 |
| 300 | 0.001 355 | 1332.8 | 3.2016 | 0.001 349 | 1331.6 | 3.1948 | 0.001 343 | 1330.5 | 3.1882 | 300 |
| 310 | 0.001 392 | 1386.4 | 3.2944 | 0.001 385 | 1384.7 | 3.2866 | 0.001 378 | 1383.1 | 3.2791 | 310 |
| 320 | 0.001 435 | 1442.5 | 3.3896 | 0.001 426 | 1439.9 | 3.3805 | 0.001 417 | 1437.6 | 3.3718 | 320 |
| 330 | 0.001 487 | 1501.7 | 3.4886 | 0.001 475 | 1498.0 | 3.4776 | 0.001 464 | 1494.7 | 3.4672 | 330 |
| 340 | 0.001 551 | 1565.3 | 3.5933 | 0.001 534 | 1559.9 | 3.5794 | 0.001 519 | 1555.2 | 3.5667 | 340 |
| 350 | 0.001 635 | 1635.9 | 3.7074 | 0.001 610 | 1627.6 | 3.6888 | 0.001 588 | 1620.4 | 3.6723 | 350 |
| 360 | 0.001 760 | 1719.5 | 3.8404 | 0.001 715 | 1704.7 | 3.8116 | 0.001 681 | 1693.2 | 3.7880 | 360 |
| 370 | 0.002 029 | 1842.6 | 4.0333 | 0.001 891 | 1802.5 | 3.9649 | 0.001 818 | 1779.6 | 3.9234 | 370 |
| 380 | 0.006 125 | 2504.6 | 5.0556 | 0.002 612 | 2025.2 | 4.3076 | 0.002 087 | 1901.1 | 4.1107 | 380 |
| 390 | 0.007 377 | 2643.7 | 5.2671 | 0.005 613 | 2500.8 | 5.0320 | 0.003 552 | 2242.7 | 4.6290 | 390 |
| 400 | 0.008 255 | 2735.8 | 5.4050 | 0.006 731 | 2637.4 | 5.2366 | 0.005 287 | 2510.6 | 5.0304 | 400 |
| 410 | 0.008 970 | 2808.4 | 5.5121 | 0.007 540 | 2730.8 | 5.3744 | 0.006 256 | 2639.5 | 5.2206 | 410 |
| 420 | 0.009 588 | 2869.9 | 5.6015 | 0.008 205 | 2804.9 | 5.4821 | 0.006 990 | 2731.8 | 5.3548 | 420 |
| 430 | 0.010 14 | 2924.3 | 5.6794 | 0.008 781 | 2867.8 | 5.5723 | 0.007 602 | 2806.1 | 5.4612 | 430 |
| 440 | 0.010 65 | 2973.6 | 5.7491 | 0.009 299 | 2923.5 | 5.6509 | 0.008 137 | 2869.7 | 5.5510 | 440 |
| 450 | 0.011 12 | 3019.0 | 5.8124 | 0.009 774 | 2974.0 | 5.7212 | 0.008 619 | 2926.1 | 5.6296 | 450 |
| 460 | 0.011 56 | 3061.6 | 5.8708 | 0.010 21 | 3020.5 | 5.7852 | 0.009 062 | 2977.3 | 5.7000 | 460 |
| 470 | 0.011 98 | 3101.7 | 5.9252 | 0.010 63 | 3064.0 | 5.8441 | 0.009 474 | 3024.6 | 5.7640 | 470 |
| 480 | 0.012 38 | 3139.9 | 5.9763 | 0.011 02 | 3105.1 | 5.8990 | 0.009 861 | 3068.8 | 5.8231 | 480 |
| 490 | 0.012 77 | 3176.5 | 6.0246 | 0.011 39 | 3144.1 | 5.9504 | 0.010 23 | 3110.5 | 5.8781 | 490 |
| 500 | 0.013 14 | 3211.8 | 6.0704 | 0.011 75 | 3181.4 | 5.9991 | 0.010 58 | 3150.2 | 5.9298 | 500 |
| 510 | 0.013 49 | 3245.9 | 6.1143 | 0.012 10 | 3217.4 | 6.0453 | 0.010 91 | 3188.1 | 5.9785 | 510 |
| 520 | 0.013 84 | 3279.0 | 6.1563 | 0.012 43 | 3252.2 | 6.0894 | 0.011 24 | 3224.6 | 6.0249 | 520 |
| 530 | 0.014 18 | 3311.3 | 6.1968 | 0.012 75 | 3285.9 | 6.1317 | 0.011 55 | 3259.9 | 6.0691 | 530 |
| 540 | 0.014 51 | 3342.9 | 6.2358 | 0.013 07 | 3318.8 | 6.1723 | 0.011 85 | 3294.2 | 6.1115 | 540 |
| 550 | 0.014 83 | 3373.8 | 6.2736 | 0.013 38 | 3350.9 | 6.2116 | 0.012 14 | 3327.6 | 6.1523 | 550 |
| 560 | 0.015 14 | 3404.1 | 6.3103 | 0.013 67 | 3382.3 | 6.2496 | 0.012 43 | 3360.2 | 6.1917 | 560 |
| 570 | 0.015 45 | 3434.0 | 6.3459 | 0.013 97 | 3413.2 | 6.2864 | 0.012 71 | 3392.1 | 6.2297 | 570 |
| 580 | 0.015 75 | 3463.4 | 6.3806 | 0.014 25 | 3443.5 | 6.3222 | 0.012 99 | 3423.4 | 6.2666 | 580 |
| 590 | 0.016 05 | 3492.5 | 6.4145 | 0.014 54 | 3473.4 | 6.3570 | 0.013 25 | 3454.1 | 6.3025 | 590 |
| 600 | 0.016 35 | 3521.2 | 6.4475 | 0.014 81 | 3502.9 | 6.3910 | 0.013 52 | 3484.4 | 6.3374 | 600 |
| 610 | 0.016 64 | 3549.6 | 6.4798 | 0.015 09 | 3532.0 | 6.4241 | 0.013 78 | 3514.3 | 6.3714 | 610 |
| 620 | 0.016 92 | 3577.7 | 6.5115 | 0.015 36 | 3560.8 | 6.4565 | 0.014 03 | 3543.8 | 6.4046 | 620 |
| 630 | 0.017 20 | 3605.5 | 6.5425 | 0.015 62 | 3589.3 | 6.4883 | 0.014 28 | 3572.9 | 6.4371 | 630 |
| 640 | 0.017 48 | 3633.2 | 6.5730 | 0.015 88 | 3617.6 | 6.5194 | 0.014 53 | 3601.8 | 6.4688 | 640 |
| 650 | 0.017 76 | 3660.6 | 6.6029 | 0.016 14 | 3645.6 | 6.5499 | 0.014 77 | 3630.4 | 6.5000 | 650 |
| 660 | 0.018 03 | 3687.9 | 6.6322 | 0.016 40 | 3673.3 | 6.5798 | 0.015 02 | 3658.7 | 6.5305 | 660 |
| 670 | 0.018 30 | 3715.0 | 6.6611 | 0.016 65 | 3700.9 | 6.6092 | 0.015 25 | 3686.8 | 6.5604 | 670 |
| 680 | 0.018 56 | 3742.0 | 6.6896 | 0.016 90 | 3728.4 | 6.6381 | 0.015 49 | 3714.7 | 6.5899 | 680 |
| 690 | 0.018 83 | 3768.8 | 6.7176 | 0.017 15 | 3755.6 | 6.6666 | 0.015 72 | 3742.4 | 6.6188 | 690 |
| 700 | 0.019 09 | 3795.5 | 6.7451 | 0.017 39 | 3782.8 | 6.6946 | 0.015 95 | 3770.0 | 6.6473 | 700 |
| 710 | 0.019 35 | 3822.1 | 6.7723 | 0.017 63 | 3809.8 | 6.7222 | 0.016 18 | 3797.4 | 6.6753 | 710 |
| 720 | 0.019 61 | 3848.6 | 6.7992 | 0.017 88 | 3836.6 | 6.7494 | 0.016 41 | 3824.6 | 6.7029 | 720 |
| 730 | 0.019 87 | 3875.0 | 6.8256 | 0.018 12 | 3863.4 | 6.7763 | 0.016 63 | 3851.8 | 6.7301 | 730 |
| 740 | 0.020 12 | 3901.4 | 6.8518 | 0.018 35 | 3890.1 | 6.8027 | 0.016 86 | 3878.8 | 6.7569 | 740 |
| 750 | 0.020 38 | 3927.6 | 6.8776 | 0.018 59 | 3916.7 | 6.8289 | 0.017 08 | 3905.8 | 6.7833 | 750 |
| 760 | 0.020 63 | 3953.8 | 6.9031 | 0.018 82 | 3943.2 | 6.8547 | 0.017 30 | 3932.6 | 6.8094 | 760 |
| 770 | 0.020 88 | 3980.0 | 6.9283 | 0.019 06 | 3969.7 | 6.8801 | 0.017 52 | 3959.4 | 6.8352 | 770 |
| 780 | 0.021 13 | 4006.1 | 6.9532 | 0.019 29 | 3996.1 | 6.9053 | 0.017 73 | 3986.1 | 6.8607 | 780 |
| 790 | 0.021 37 | 4032.2 | 6.9778 | 0.019 52 | 4022.4 | 6.9302 | 0.017 95 | 4012.7 | 6.8858 | 790 |
| 800 | 0.021 62 | 4058.2 | 7.0022 | 0.019 75 | 4048.8 | 6.9549 | 0.018 16 | 4039.3 | 6.9107 | 800 |

UNITS: $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| t (°C) | 28 MPa | | | 30 MPa | | | 32 MPa | | | t (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | v | h | s | v | h | s | v | h | s | |
| 0 | 0.000 986 6 | 27.91 | 0.0003 | 0.000 985 7 | 29.86 | 0.0003 | 0.000 984 7 | 31.81 | 0.0002 | 0 |
| 5 | 0.000 986 9 | 48.40 | 0.0747 | 0.000 986 0 | 50.32 | 0.0745 | 0.000 985 1 | 52.23 | 0.0743 | 5 |
| 10 | 0.000 987 5 | 68.90 | 0.1477 | 0.000 986 6 | 70.79 | 0.1474 | 0.000 985 8 | 72.67 | 0.1471 | 10 |
| 15 | 0.000 988 4 | 89.41 | 0.2196 | 0.000 987 5 | 91.27 | 0.2192 | 0.000 986 7 | 93.13 | 0.2187 | 15 |
| 20 | 0.000 989 5 | 109.94 | 0.2902 | 0.000 988 7 | 111.78 | 0.2897 | 0.000 987 8 | 113.61 | 0.2892 | 20 |
| 25 | 0.000 990 8 | 130.48 | 0.3597 | 0.000 990 0 | 132.29 | 0.3591 | 0.000 989 2 | 134.10 | 0.3585 | 25 |
| 30 | 0.000 992 3 | 151.03 | 0.4280 | 0.000 991 5 | 152.82 | 0.4274 | 0.000 990 7 | 154.60 | 0.4267 | 30 |
| 35 | 0.000 994 0 | 171.59 | 0.4953 | 0.000 993 2 | 173.36 | 0.4946 | 0.000 992 4 | 175.12 | 0.4939 | 35 |
| 40 | 0.000 995 9 | 192.17 | 0.5615 | 0.000 995 1 | 193.91 | 0.5607 | 0.000 994 3 | 195.65 | 0.5599 | 40 |
| 45 | 0.000 998 0 | 212.75 | 0.6267 | 0.000 997 1 | 214.47 | 0.6259 | 0.000 996 3 | 216.20 | 0.6250 | 45 |
| 50 | 0.001 000 2 | 233.34 | 0.6910 | 0.000 999 3 | 235.05 | 0.6900 | 0.000 998 5 | 236.75 | 0.6891 | 50 |
| 55 | 0.001 002 5 | 253.95 | 0.7542 | 0.001 001 7 | 255.64 | 0.7533 | 0.001 000 9 | 257.32 | 0.7523 | 55 |
| 60 | 0.001 005 0 | 274.57 | 0.8166 | 0.001 004 2 | 276.24 | 0.8156 | 0.001 003 4 | 277.90 | 0.8145 | 60 |
| 65 | 0.001 007 6 | 295.20 | 0.8781 | 0.001 006 8 | 296.85 | 0.8770 | 0.001 006 0 | 298.50 | 0.8759 | 65 |
| 70 | 0.001 010 4 | 315.85 | 0.9387 | 0.001 009 6 | 317.48 | 0.9376 | 0.001 008 7 | 319.11 | 0.9364 | 70 |
| 75 | 0.001 013 3 | 336.52 | 0.9985 | 0.001 012 5 | 338.13 | 0.9973 | 0.001 011 6 | 339.74 | 0.9961 | 75 |
| 80 | 0.001 016 4 | 357.20 | 1.0575 | 0.001 015 5 | 358.80 | 1.0562 | 0.001 014 7 | 360.39 | 1.0550 | 80 |
| 85 | 0.001 019 6 | 377.91 | 1.1157 | 0.001 018 7 | 379.48 | 1.1144 | 0.001 017 8 | 381.06 | 1.1131 | 85 |
| 90 | 0.001 022 9 | 398.63 | 1.1732 | 0.001 022 0 | 400.19 | 1.1718 | 0.001 021 1 | 401.74 | 1.1705 | 90 |
| 95 | 0.001 026 3 | 419.38 | 1.2299 | 0.001 025 4 | 420.92 | 1.2285 | 0.001 024 5 | 422.46 | 1.2271 | 95 |
| 100 | 0.001 029 9 | 440.16 | 1.2859 | 0.001 029 0 | 441.67 | 1.2845 | 0.001 028 1 | 443.19 | 1.2830 | 100 |
| 105 | 0.001 033 6 | 460.96 | 1.3413 | 0.001 032 7 | 462.45 | 1.3398 | 0.001 031 8 | 463.95 | 1.3383 | 105 |
| 110 | 0.001 037 5 | 481.79 | 1.3960 | 0.001 036 5 | 483.26 | 1.3945 | 0.001 035 6 | 484.74 | 1.3929 | 110 |
| 115 | 0.001 041 4 | 502.64 | 1.4501 | 0.001 040 5 | 504.10 | 1.4485 | 0.001 039 5 | 505.56 | 1.4469 | 115 |
| 120 | 0.001 045 6 | 523.53 | 1.5036 | 0.001 044 6 | 524.97 | 1.5019 | 0.001 043 6 | 526.41 | 1.5003 | 120 |
| 125 | 0.001 049 8 | 544.46 | 1.5565 | 0.001 048 8 | 545.87 | 1.5548 | 0.001 047 8 | 547.29 | 1.5531 | 125 |
| 130 | 0.001 054 2 | 565.42 | 1.6088 | 0.001 053 1 | 566.81 | 1.6070 | 0.001 052 1 | 568.20 | 1.6053 | 130 |
| 135 | 0.001 058 7 | 586.42 | 1.6606 | 0.001 057 6 | 587.79 | 1.6587 | 0.001 056 6 | 589.16 | 1.6569 | 135 |
| 140 | 0.001 063 4 | 607.46 | 1.7118 | 0.001 062 3 | 608.80 | 1.7099 | 0.001 061 2 | 610.15 | 1.7080 | 140 |
| 145 | 0.001 068 2 | 628.54 | 1.7625 | 0.001 067 0 | 629.86 | 1.7606 | 0.001 065 9 | 631.18 | 1.7586 | 145 |
| 150 | 0.001 073 1 | 649.67 | 1.8128 | 0.001 072 0 | 650.96 | 1.8107 | 0.001 070 8 | 652.26 | 1.8088 | 150 |
| 155 | 0.001 078 3 | 670.85 | 1.8625 | 0.001 077 0 | 672.11 | 1.8604 | 0.001 075 8 | 673.39 | 1.8584 | 155 |
| 160 | 0.001 083 5 | 692.07 | 1.9118 | 0.001 082 3 | 693.31 | 1.9097 | 0.001 081 0 | 694.56 | 1.9076 | 160 |
| 165 | 0.001 089 0 | 713.36 | 1.9607 | 0.001 087 7 | 714.57 | 1.9585 | 0.001 086 4 | 715.79 | 1.9563 | 165 |
| 170 | 0.001 094 6 | 734.70 | 2.0091 | 0.001 093 2 | 735.88 | 2.0068 | 0.001 091 9 | 737.07 | 2.0046 | 170 |
| 175 | 0.001 100 | 756.10 | 2.0571 | 0.001 099 0 | 757.25 | 2.0548 | 0.001 097 6 | 758.41 | 2.0525 | 175 |
| 180 | 0.001 106 | 777.56 | 2.1047 | 0.001 105 | 778.68 | 2.1023 | 0.001 103 | 779.81 | 2.0999 | 180 |
| 185 | 0.001 112 | 799.10 | 2.1520 | 0.001 111 | 800.19 | 2.1495 | 0.001 110 | 801.28 | 2.1471 | 185 |
| 190 | 0.001 119 | 820.71 | 2.1989 | 0.001 117 | 821.76 | 2.1964 | 0.001 116 | 822.81 | 2.1938 | 190 |
| 195 | 0.001 125 | 842.40 | 2.2455 | 0.001 124 | 843.41 | 2.2429 | 0.001 122 | 844.43 | 2.2402 | 195 |
| 200 | 0.001 132 | 864.17 | 2.2918 | 0.001 130 | 865.14 | 2.2890 | 0.001 129 | 866.12 | 2.2863 | 200 |
| 205 | 0.001 139 | 886.03 | 2.3377 | 0.001 137 | 886.96 | 2.3349 | 0.001 136 | 887.90 | 2.3321 | 205 |
| 210 | 0.001 146 | 907.99 | 2.3834 | 0.001 144 | 908.87 | 2.3805 | 0.001 143 | 909.76 | 2.3776 | 210 |
| 215 | 0.001 154 | 930.04 | 2.4288 | 0.001 152 | 930.87 | 2.4258 | 0.001 150 | 931.72 | 2.4228 | 215 |
| 220 | 0.001 161 | 952.20 | 2.4740 | 0.001 159 | 952.99 | 2.4709 | 0.001 158 | 953.78 | 2.4678 | 220 |
| 225 | 0.001 169 | 974.48 | 2.5189 | 0.001 167 | 975.21 | 2.5157 | 0.001 165 | 975.95 | 2.5125 | 225 |
| 230 | 0.001 178 | 996.88 | 2.5637 | 0.001 176 | 997.55 | 2.5603 | 0.001 173 | 998.24 | 2.5570 | 230 |
| 235 | 0.001 186 | 1019.4 | 2.6082 | 0.001 184 | 1020.0 | 2.6048 | 0.001 182 | 1020.6 | 2.6013 | 235 |
| 240 | 0.001 195 | 1042.1 | 2.6526 | 0.001 193 | 1042.6 | 2.6490 | 0.001 190 | 1043.2 | 2.6455 | 240 |
| 245 | 0.001 204 | 1064.9 | 2.6969 | 0.001 202 | 1065.4 | 2.6931 | 0.001 199 | 1065.9 | 2.6894 | 245 |
| 250 | 0.001 214 | 1087.9 | 2.7410 | 0.001 211 | 1088.3 | 2.7371 | 0.001 209 | 1088.7 | 2.7333 | 250 |
| 255 | 0.001 224 | 1111.0 | 2.7850 | 0.001 221 | 1111.3 | 2.7810 | 0.001 218 | 1111.7 | 2.7770 | 255 |
| 260 | 0.001 234 | 1134.3 | 2.8290 | 0.001 231 | 1134.6 | 2.8248 | 0.001 228 | 1134.8 | 2.8206 | 260 |
| 265 | 0.001 245 | 1157.9 | 2.8729 | 0.001 242 | 1158.0 | 2.8685 | 0.001 239 | 1158.2 | 2.8642 | 265 |
| 270 | 0.001 257 | 1181.6 | 2.9168 | 0.001 253 | 1181.6 | 2.9122 | 0.001 250 | 1181.7 | 2.9077 | 270 |

**UNITS:** $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 28 MPa | | | 30 MPa | | | 32 MPa | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *t* (°C) | *v* | *h* | *s* | *v* | *h* | *s* | *v* | *h* | *s* | *t* (°C) |
| **275** | 0.001 268 | 1205.6 | 2.9607 | 0.001 265 | 1205.5 | 2.9559 | 0.001 261 | 1205.4 | 2.9512 | **275** |
| **280** | 0.001 281 | 1229.8 | 3.0047 | 0.001 277 | 1229.6 | 2.9997 | 0.001 273 | 1229.4 | 2.9947 | **280** |
| **285** | 0.001 294 | 1254.3 | 3.0488 | 0.001 290 | 1253.9 | 3.0435 | 0.001 286 | 1253.6 | 3.0383 | **285** |
| **290** | 0.001 308 | 1279.0 | 3.0929 | 0.001 303 | 1278.5 | 3.0874 | 0.001 299 | 1278.1 | 3.0819 | **290** |
| **295** | 0.001 322 | 1304.1 | 3.1373 | 0.001 317 | 1303.4 | 3.1314 | 0.001 313 | 1302.8 | 3.1257 | **295** |
| **300** | 0.001 338 | 1329.5 | 3.1818 | 0.001 332 | 1328.7 | 3.1756 | 0.001 327 | 1327.9 | 3.1696 | **300** |
| **310** | 0.001 371 | 1381.6 | 3.2718 | 0.001 365 | 1380.2 | 3.2648 | 0.001 359 | 1379.0 | 3.2581 | **310** |
| **320** | 0.001 409 | 1435.5 | 3.3634 | 0.001 401 | 1433.5 | 3.3554 | 0.001 394 | 1431.7 | 3.3477 | **320** |
| **330** | 0.001 453 | 1491.7 | 3.4574 | 0.001 444 | 1488.9 | 3.4481 | 0.001 435 | 1486.4 | 3.4392 | **330** |
| **340** | 0.001 506 | 1550.9 | 3.5548 | 0.001 493 | 1547.1 | 3.5437 | 0.001 482 | 1543.6 | 3.5332 | **340** |
| **350** | 0.001 570 | 1614.3 | 3.6573 | 0.001 553 | 1608.8 | 3.6435 | 0.001 538 | 1603.9 | 3.6308 | **350** |
| **360** | 0.001 652 | 1683.6 | 3.7677 | 0.001 628 | 1675.6 | 3.7498 | 0.001 607 | 1668.6 | 3.7336 | **360** |
| **370** | 0.001 766 | 1763.1 | 3.8922 | 0.001 727 | 1750.2 | 3.8667 | 0.001 695 | 1739.6 | 3.8449 | **370** |
| **380** | 0.001 952 | 1862.4 | 4.0454 | 0.001 873 | 1838.3 | 4.0026 | 0.001 817 | 1820.5 | 3.9698 | **380** |
| **390** | 0.002 398 | 2022.3 | 4.2882 | 0.002 133 | 1955.2 | 4.1802 | 0.002 006 | 1919.4 | 4.1199 | **390** |
| **400** | 0.003 855 | 2334.4 | 4.7552 | 0.002 796 | 2152.4 | 4.4750 | 0.002 367 | 2056.8 | 4.3255 | **400** |
| **410** | 0.005 071 | 2529.1 | 5.0424 | 0.003 984 | 2395.8 | 4.8342 | 0.003 127 | 2258.5 | 4.6228 | **410** |
| **420** | 0.005 904 | 2648.5 | 5.2160 | 0.004 921 | 2552.9 | 5.0625 | 0.004 053 | 2446.5 | 4.8961 | **420** |
| **430** | 0.006 563 | 2738.1 | 5.3444 | 0.005 638 | 2662.8 | 5.2201 | 0.004 812 | 2579.9 | 5.0873 | **430** |
| **440** | 0.007 123 | 2811.6 | 5.4483 | 0.006 228 | 2748.9 | 5.3416 | 0.005 434 | 2681.2 | 5.2303 | **440** |
| **450** | 0.007 617 | 2875.1 | 5.5367 | 0.006 738 | 2820.9 | 5.4419 | 0.005 961 | 2763.3 | 5.3448 | **450** |
| **460** | 0.008 065 | 2931.8 | 5.6145 | 0.007 193 | 2883.8 | 5.5284 | 0.006 426 | 2833.5 | 5.4411 | **460** |
| **470** | 0.008 477 | 2983.4 | 5.6845 | 0.007 608 | 2940.3 | 5.6049 | 0.006 845 | 2895.4 | 5.5251 | **470** |
| **480** | 0.008 862 | 3031.1 | 5.7483 | 0.007 992 | 2992.0 | 5.6740 | 0.007 229 | 2951.4 | 5.5999 | **480** |
| **490** | 0.009 224 | 3075.8 | 5.8072 | 0.008 352 | 3039.9 | 5.7372 | 0.007 586 | 3002.9 | 5.6678 | **490** |
| **500** | 0.009 568 | 3117.9 | 5.8621 | 0.008 690 | 3084.8 | 5.7956 | 0.007 922 | 3050.7 | 5.7301 | **500** |
| **510** | 0.009 895 | 3158.1 | 5.9136 | 0.009 012 | 3127.2 | 5.8502 | 0.008 239 | 3095.7 | 5.7879 | **510** |
| **520** | 0.010 21 | 3196.5 | 5.9624 | 0.009 320 | 3167.7 | 5.9015 | 0.008 540 | 3138.3 | 5.8419 | **520** |
| **530** | 0.010 51 | 3233.4 | 6.0087 | 0.009 615 | 3206.4 | 5.9500 | 0.008 829 | 3178.9 | 5.8928 | **530** |
| **540** | 0.010 81 | 3269.2 | 6.0529 | 0.009 899 | 3243.7 | 5.9962 | 0.009 107 | 3217.8 | 5.9410 | **540** |
| **550** | 0.011 09 | 3303.9 | 6.0953 | 0.010 17 | 3279.8 | 6.0403 | 0.009 375 | 3255.3 | 5.9868 | **550** |
| **560** | 0.011 37 | 3337.7 | 6.1361 | 0.010 44 | 3314.8 | 6.0826 | 0.009 634 | 3291.7 | 6.0307 | **560** |
| **570** | 0.011 63 | 3370.6 | 6.1755 | 0.010 70 | 3348.9 | 6.1233 | 0.009 886 | 3327.0 | 6.0728 | **570** |
| **580** | 0.011 90 | 3402.9 | 6.2136 | 0.010 95 | 3382.3 | 6.1626 | 0.010 13 | 3361.4 | 6.1134 | **580** |
| **590** | 0.012 15 | 3434.6 | 6.2505 | 0.011 20 | 3414.9 | 6.2006 | 0.010 37 | 3394.9 | 6.1525 | **590** |
| **600** | 0.012 41 | 3465.7 | 6.2863 | 0.011 44 | 3446.9 | 6.2374 | 0.010 60 | 3427.8 | 6.1904 | **600** |
| **610** | 0.012 65 | 3496.4 | 6.3212 | 0.011 68 | 3478.3 | 6.2732 | 0.010 83 | 3460.1 | 6.2271 | **610** |
| **620** | 0.012 90 | 3526.6 | 6.3552 | 0.011 91 | 3509.3 | 6.3081 | 0.011 06 | 3491.8 | 6.2629 | **620** |
| **630** | 0.013 14 | 3556.4 | 6.3885 | 0.012 14 | 3539.8 | 6.3421 | 0.011 28 | 3523.0 | 6.2976 | **630** |
| **640** | 0.013 37 | 3585.9 | 6.4209 | 0.012 37 | 3569.9 | 6.3752 | 0.011 49 | 3553.8 | 6.3315 | **640** |
| **650** | 0.013 60 | 3615.1 | 6.4527 | 0.012 59 | 3599.7 | 6.4077 | 0.011 70 | 3584.2 | 6.3646 | **650** |
| **660** | 0.013 83 | 3643.9 | 6.4838 | 0.012 81 | 3629.1 | 6.4394 | 0.011 91 | 3614.2 | 6.3969 | **660** |
| **670** | 0.014 06 | 3672.6 | 6.5143 | 0.013 02 | 3658.3 | 6.4705 | 0.012 12 | 3643.9 | 6.4286 | **670** |
| **680** | 0.014 28 | 3701.0 | 6.5442 | 0.013 24 | 3687.2 | 6.5009 | 0.012 32 | 3673.3 | 6.4596 | **680** |
| **690** | 0.014 50 | 3729.1 | 6.5737 | 0.013 45 | 3715.8 | 6.5308 | 0.012 52 | 3702.4 | 6.4900 | **690** |
| **700** | 0.014 72 | 3757.1 | 6.6026 | 0.013 65 | 3744.2 | 6.5602 | 0.012 72 | 3731.3 | 6.5198 | **700** |
| **710** | 0.014 94 | 3784.9 | 6.6310 | 0.013 86 | 3772.5 | 6.5891 | 0.012 92 | 3760.0 | 6.5491 | **710** |
| **720** | 0.015 15 | 3812.6 | 6.6590 | 0.014 06 | 3800.5 | 6.6175 | 0.013 11 | 3788.4 | 6.5779 | **720** |
| **730** | 0.015 36 | 3840.1 | 6.6866 | 0.014 26 | 3828.4 | 6.6454 | 0.013 30 | 3816.7 | 6.6063 | **730** |
| **740** | 0.015 57 | 3867.5 | 6.7137 | 0.014 46 | 3856.2 | 6.6729 | 0.013 49 | 3844.8 | 6.6341 | **740** |
| **750** | 0.015 78 | 3894.8 | 6.7405 | 0.014 66 | 3883.8 | 6.7000 | 0.013 68 | 3872.8 | 6.6616 | **750** |
| **760** | 0.015 99 | 3921.9 | 6.7669 | 0.014 86 | 3911.3 | 6.7268 | 0.013 87 | 3900.6 | 6.6887 | **760** |
| **770** | 0.016 20 | 3949.0 | 6.7930 | 0.015 05 | 3938.7 | 6.7532 | 0.014 05 | 3928.3 | 6.7153 | **770** |
| **780** | 0.016 40 | 3976.0 | 6.8188 | 0.015 25 | 3965.9 | 6.7792 | 0.014 24 | 3955.9 | 6.7416 | **780** |
| **790** | 0.016 60 | 4002.9 | 6.8442 | 0.015 44 | 3993.1 | 6.8049 | 0.014 42 | 3983.3 | 6.7676 | **790** |
| **800** | 0.016 80 | 4029.7 | 6.8693 | 0.015 63 | 4020.2 | 6.8303 | 0.014 60 | 4010.7 | 6.7932 | **800** |

**UNITS**: *v* in $m^3$/kg ; *h* in kJ/kg ; *s* in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 35 MPa | | | 40 MPa | | | 45 MPa | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *t* (°C) | *v* | *h* | *s* | *v* | *h* | *s* | *v* | *h* | *s* | *t* (°C) |
| 0 | 0.000 983 4 | 34.72 | 0.0001 | 0.000 981 1 | 39.56 | -0.0002 | 0.000 978 9 | 44.36 | -0.0006 | 0 |
| 5 | 0.000 983 8 | 55.09 | 0.0740 | 0.000 981 6 | 59.85 | 0.0734 | 0.000 979 4 | 64.57 | 0.0727 | 5 |
| 10 | 0.000 984 5 | 75.49 | 0.1466 | 0.000 982 3 | 80.17 | 0.1458 | 0.000 980 2 | 84.83 | 0.1449 | 10 |
| 15 | 0.000 985 4 | 95.91 | 0.2181 | 0.000 983 3 | 100.52 | 0.2171 | 0.000 981 3 | 105.12 | 0.2160 | 15 |
| 20 | 0.000 986 6 | 116.35 | 0.2884 | 0.000 984 5 | 120.90 | 0.2872 | 0.000 982 5 | 125.44 | 0.2859 | 20 |
| 25 | 0.000 987 9 | 136.81 | 0.3576 | 0.000 985 9 | 141.30 | 0.3562 | 0.000 983 9 | 145.78 | 0.3547 | 25 |
| 30 | 0.000 989 5 | 157.28 | 0.4257 | 0.000 987 4 | 161.72 | 0.4241 | 0.000 985 5 | 166.15 | 0.4224 | 30 |
| 35 | 0.000 991 2 | 177.77 | 0.4928 | 0.000 989 2 | 182.16 | 0.4910 | 0.000 987 2 | 186.54 | 0.4891 | 35 |
| 40 | 0.000 993 1 | 198.27 | 0.5588 | 0.000 991 1 | 202.61 | 0.5568 | 0.000 989 1 | 206.94 | 0.5548 | 40 |
| 45 | 0.000 995 1 | 218.78 | 0.6238 | 0.000 993 1 | 223.08 | 0.6216 | 0.000 991 1 | 227.36 | 0.6195 | 45 |
| 50 | 0.000 997 3 | 239.31 | 0.6878 | 0.000 995 3 | 243.56 | 0.6855 | 0.000 993 3 | 247.80 | 0.6832 | 50 |
| 55 | 0.000 999 6 | 259.85 | 0.7508 | 0.000 997 6 | 264.05 | 0.7484 | 0.000 995 7 | 268.25 | 0.7460 | 55 |
| 60 | 0.001 002 1 | 280.40 | 0.8130 | 0.001 000 1 | 284.56 | 0.8105 | 0.000 998 1 | 288.71 | 0.8079 | 60 |
| 65 | 0.001 004 7 | 300.97 | 0.8743 | 0.001 002 7 | 305.08 | 0.8716 | 0.001 000 7 | 309.19 | 0.8690 | 65 |
| 70 | 0.001 007 5 | 321.56 | 0.9347 | 0.001 005 4 | 325.62 | 0.9319 | 0.001 003 4 | 329.69 | 0.9291 | 70 |
| 75 | 0.001 010 4 | 342.16 | 0.9943 | 0.001 008 3 | 346.18 | 0.9914 | 0.001 006 3 | 350.20 | 0.9885 | 75 |
| 80 | 0.001 013 4 | 362.78 | 1.0531 | 0.001 011 3 | 366.76 | 1.0501 | 0.001 009 2 | 370.74 | 1.0470 | 80 |
| 85 | 0.001 016 5 | 383.42 | 1.1112 | 0.001 014 4 | 387.35 | 1.1080 | 0.001 012 3 | 391.29 | 1.1048 | 85 |
| 90 | 0.001 019 8 | 404.08 | 1.1685 | 0.001 017 6 | 407.97 | 1.1651 | 0.001 015 5 | 411.86 | 1.1619 | 90 |
| 95 | 0.001 023 2 | 424.76 | 1.2250 | 0.001 021 0 | 428.60 | 1.2216 | 0.001 018 8 | 432.45 | 1.2182 | 95 |
| 100 | 0.001 026 7 | 445.47 | 1.2809 | 0.001 024 5 | 449.27 | 1.2773 | 0.001 022 3 | 453.07 | 1.2738 | 100 |
| 105 | 0.001 030 4 | 466.20 | 1.3361 | 0.001 028 1 | 469.95 | 1.3324 | 0.001 025 9 | 473.71 | 1.3287 | 105 |
| 110 | 0.001 034 1 | 486.96 | 1.3906 | 0.001 031 8 | 490.66 | 1.3868 | 0.001 029 5 | 494.37 | 1.3830 | 110 |
| 115 | 0.001 038 1 | 507.75 | 1.4445 | 0.001 035 7 | 511.40 | 1.4406 | 0.001 033 3 | 515.06 | 1.4367 | 115 |
| 120 | 0.001 042 1 | 528.56 | 1.4978 | 0.001 039 7 | 532.17 | 1.4937 | 0.001 037 3 | 535.78 | 1.4897 | 120 |
| 125 | 0.001 046 2 | 549.42 | 1.5505 | 0.001 043 8 | 552.97 | 1.5463 | 0.001 041 3 | 556.53 | 1.5422 | 125 |
| 130 | 0.001 050 5 | 570.30 | 1.6026 | 0.001 048 0 | 573.80 | 1.5983 | 0.001 045 5 | 577.31 | 1.5940 | 130 |
| 135 | 0.001 055 0 | 591.22 | 1.6542 | 0.001 052 4 | 594.67 | 1.6497 | 0.001 049 8 | 598.13 | 1.6454 | 135 |
| 140 | 0.001 059 5 | 612.18 | 1.7052 | 0.001 056 9 | 615.57 | 1.7006 | 0.001 054 2 | 618.98 | 1.6961 | 140 |
| 145 | 0.001 064 2 | 633.18 | 1.7558 | 0.001 061 5 | 636.51 | 1.7510 | 0.001 058 8 | 639.86 | 1.7464 | 145 |
| 150 | 0.001 069 1 | 654.22 | 1.8058 | 0.001 066 3 | 657.49 | 1.8009 | 0.001 063 5 | 660.78 | 1.7961 | 150 |
| 155 | 0.001 074 1 | 675.30 | 1.8553 | 0.001 071 2 | 678.52 | 1.8503 | 0.001 068 3 | 681.75 | 1.8454 | 155 |
| 160 | 0.001 079 2 | 696.44 | 1.9044 | 0.001 076 2 | 699.59 | 1.8992 | 0.001 073 3 | 702.76 | 1.8941 | 160 |
| 165 | 0.001 084 5 | 717.62 | 1.9530 | 0.001 081 4 | 720.70 | 1.9477 | 0.001 078 4 | 723.81 | 1.9425 | 165 |
| 170 | 0.001 090 0 | 738.86 | 2.0012 | 0.001 086 8 | 741.87 | 1.9957 | 0.001 083 7 | 744.91 | 1.9904 | 170 |
| 175 | 0.001 095 6 | 760.15 | 2.0490 | 0.001 092 3 | 763.09 | 2.0434 | 0.001 089 1 | 766.06 | 2.0378 | 175 |
| 180 | 0.001 101 | 781.51 | 2.0964 | 0.001 098 0 | 784.37 | 2.0906 | 0.001 094 6 | 787.27 | 2.0849 | 180 |
| 185 | 0.001 107 | 802.93 | 2.1434 | 0.001 104 | 805.71 | 2.1374 | 0.001 100 | 808.53 | 2.1315 | 185 |
| 190 | 0.001 113 | 824.41 | 2.1900 | 0.001 110 | 827.11 | 2.1839 | 0.001 106 | 829.85 | 2.1778 | 190 |
| 195 | 0.001 120 | 845.97 | 2.2363 | 0.001 116 | 848.58 | 2.2300 | 0.001 112 | 851.24 | 2.2238 | 195 |
| 200 | 0.001 126 | 867.61 | 2.2823 | 0.001 122 | 870.12 | 2.2758 | 0.001 119 | 872.69 | 2.2693 | 200 |
| 205 | 0.001 133 | 889.32 | 2.3280 | 0.001 129 | 891.74 | 2.3212 | 0.001 125 | 894.22 | 2.3146 | 205 |
| 210 | 0.001 140 | 911.12 | 2.3733 | 0.001 136 | 913.44 | 2.3663 | 0.001 132 | 915.82 | 2.3595 | 210 |
| 215 | 0.001 147 | 933.01 | 2.4184 | 0.001 143 | 935.22 | 2.4112 | 0.001 138 | 937.50 | 2.4042 | 215 |
| 220 | 0.001 155 | 955.00 | 2.4632 | 0.001 150 | 957.10 | 2.4558 | 0.001 145 | 959.27 | 2.4485 | 220 |
| 225 | 0.001 162 | 977.09 | 2.5078 | 0.001 157 | 979.07 | 2.5001 | 0.001 153 | 981.12 | 2.4926 | 225 |
| 230 | 0.001 170 | 999.30 | 2.5521 | 0.001 165 | 1001.1 | 2.5442 | 0.001 160 | 1003.1 | 2.5365 | 230 |
| 235 | 0.001 178 | 1021.6 | 2.5963 | 0.001 173 | 1023.3 | 2.5881 | 0.001 168 | 1025.1 | 2.5801 | 235 |
| 240 | 0.001 187 | 1044.1 | 2.6402 | 0.001 181 | 1045.6 | 2.6317 | 0.001 176 | 1047.3 | 2.6235 | 240 |
| 245 | 0.001 196 | 1066.6 | 2.6840 | 0.001 190 | 1068.0 | 2.6752 | 0.001 184 | 1069.6 | 2.6667 | 245 |
| 250 | 0.001 205 | 1089.4 | 2.7276 | 0.001 199 | 1090.6 | 2.7185 | 0.001 193 | 1092.0 | 2.7097 | 250 |
| 255 | 0.001 214 | 1112.2 | 2.7711 | 0.001 208 | 1113.3 | 2.7617 | 0.001 202 | 1114.5 | 2.7525 | 255 |
| 260 | 0.001 224 | 1135.2 | 2.8145 | 0.001 217 | 1136.1 | 2.8047 | 0.001 211 | 1137.1 | 2.7952 | 260 |
| 265 | 0.001 234 | 1158.4 | 2.8579 | 0.001 227 | 1159.1 | 2.8476 | 0.001 220 | 1159.9 | 2.8378 | 265 |
| 270 | 0.001 245 | 1181.8 | 2.9011 | 0.001 237 | 1182.3 | 2.8905 | 0.001 230 | 1182.9 | 2.8803 | 270 |

UNITS: $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| t (°C) | 35 MPa | | | 40 MPa | | | 45 MPa | | | t (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | v | h | s | v | h | s | v | h | s | |
| 275 | 0.001 256 | 1205.4 | 2.9443 | 0.001 248 | 1205.6 | 2.9332 | 0.001 240 | 1206.0 | 2.9226 | 275 |
| 280 | 0.001 268 | 1229.2 | 2.9875 | 0.001 259 | 1229.1 | 2.9760 | 0.001 251 | 1229.3 | 2.9649 | 280 |
| 285 | 0.001 280 | 1253.2 | 3.0307 | 0.001 271 | 1252.9 | 3.0187 | 0.001 262 | 1252.8 | 3.0072 | 285 |
| 290 | 0.001 292 | 1277.5 | 3.0740 | 0.001 283 | 1276.8 | 3.0614 | 0.001 273 | 1276.4 | 3.0494 | 290 |
| 295 | 0.001 306 | 1302.0 | 3.1174 | 0.001 295 | 1301.0 | 3.1041 | 0.001 285 | 1300.3 | 3.0916 | 295 |
| 300 | 0.001 320 | 1326.8 | 3.1608 | 0.001 308 | 1325.4 | 3.1469 | 0.001 298 | 1324.4 | 3.1338 | 300 |
| 310 | 0.001 350 | 1377.4 | 3.2483 | 0.001 337 | 1375.1 | 3.2329 | 0.001 324 | 1373.3 | 3.2185 | 310 |
| 320 | 0.001 384 | 1429.4 | 3.3367 | 0.001 368 | 1426.0 | 3.3195 | 0.001 354 | 1423.3 | 3.3035 | 320 |
| 330 | 0.001 422 | 1483.1 | 3.4265 | 0.001 403 | 1478.4 | 3.4070 | 0.001 386 | 1474.6 | 3.3892 | 330 |
| 340 | 0.001 466 | 1539.0 | 3.5184 | 0.001 443 | 1532.5 | 3.4960 | 0.001 423 | 1527.3 | 3.4758 | 340 |
| 350 | 0.001 517 | 1597.5 | 3.6131 | 0.001 488 | 1588.7 | 3.5870 | 0.001 464 | 1581.7 | 3.5638 | 350 |
| 360 | 0.001 579 | 1659.6 | 3.7119 | 0.001 542 | 1647.6 | 3.6807 | 0.001 511 | 1638.2 | 3.6538 | 360 |
| 370 | 0.001 656 | 1726.6 | 3.8169 | 0.001 605 | 1709.9 | 3.7783 | 0.001 565 | 1697.3 | 3.7464 | 370 |
| 380 | 0.001 755 | 1800.5 | 3.9309 | 0.001 682 | 1776.7 | 3.8814 | 0.001 630 | 1759.6 | 3.8425 | 380 |
| 390 | 0.001 893 | 1885.3 | 4.0597 | 0.001 780 | 1849.6 | 3.9921 | 0.001 707 | 1826.0 | 3.9433 | 390 |
| 400 | 0.002 106 | 1988.4 | 4.2140 | 0.001 911 | 1931.1 | 4.1141 | 0.001 804 | 1897.6 | 4.0505 | 400 |
| 410 | 0.002 474 | 2123.6 | 4.4133 | 0.002 093 | 2025.2 | 4.2527 | 0.001 926 | 1976.0 | 4.1661 | 410 |
| 420 | 0.003 082 | 2291.3 | 4.6570 | 0.002 361 | 2136.3 | 4.4142 | 0.002 088 | 2063.3 | 4.2930 | 420 |
| 430 | 0.003 782 | 2447.7 | 4.8811 | 0.002 742 | 2263.8 | 4.5969 | 0.002 302 | 2160.9 | 4.4327 | 430 |
| 440 | 0.004 413 | 2571.6 | 5.0561 | 0.003 210 | 2394.0 | 4.7807 | 0.002 581 | 2267.5 | 4.5833 | 440 |
| 450 | 0.004 959 | 2671.0 | 5.1945 | 0.003 693 | 2511.8 | 4.9447 | 0.002 915 | 2377.3 | 4.7362 | 450 |
| 460 | 0.005 436 | 2753.5 | 5.3079 | 0.004 149 | 2613.3 | 5.0842 | 0.003 278 | 2482.6 | 4.8808 | 460 |
| 470 | 0.005 861 | 2824.8 | 5.4045 | 0.004 567 | 2700.7 | 5.2026 | 0.003 642 | 2579.0 | 5.0114 | 470 |
| 480 | 0.006 246 | 2888.1 | 5.4890 | 0.004 950 | 2777.2 | 5.3048 | 0.003 992 | 2665.4 | 5.1269 | 480 |
| 490 | 0.006 602 | 2945.3 | 5.5646 | 0.005 300 | 2845.2 | 5.3946 | 0.004 324 | 2743.1 | 5.2294 | 490 |
| 500 | 0.006 933 | 2998.0 | 5.6331 | 0.005 625 | 2906.7 | 5.4746 | 0.004 634 | 2813.4 | 5.3209 | 500 |
| 510 | 0.007 245 | 3047.0 | 5.6961 | 0.005 928 | 2963.1 | 5.5471 | 0.004 925 | 2877.3 | 5.4030 | 510 |
| 520 | 0.007 540 | 3093.1 | 5.7546 | 0.006 213 | 3015.4 | 5.6135 | 0.005 199 | 2936.1 | 5.4776 | 520 |
| 530 | 0.007 821 | 3136.7 | 5.8092 | 0.006 483 | 3064.4 | 5.6749 | 0.005 458 | 2990.7 | 5.5461 | 530 |
| 540 | 0.008 089 | 3178.2 | 5.8606 | 0.006 740 | 3110.7 | 5.7322 | 0.005 704 | 3041.9 | 5.6094 | 540 |
| 550 | 0.008 348 | 3218.1 | 5.9093 | 0.006 985 | 3154.6 | 5.7859 | 0.005 938 | 3090.2 | 5.6685 | 550 |
| 560 | 0.008 597 | 3256.5 | 5.9557 | 0.007 221 | 3196.7 | 5.8366 | 0.006 163 | 3136.0 | 5.7238 | 560 |
| 570 | 0.008 838 | 3293.6 | 6.0000 | 0.007 449 | 3237.0 | 5.8848 | 0.006 379 | 3179.8 | 5.7761 | 570 |
| 580 | 0.009 073 | 3329.6 | 6.0425 | 0.007 669 | 3276.0 | 5.9308 | 0.006 587 | 3221.8 | 5.8256 | 580 |
| 590 | 0.009 301 | 3364.7 | 6.0834 | 0.007 882 | 3313.8 | 5.9747 | 0.006 788 | 3262.3 | 5.8728 | 590 |
| 600 | 0.009 523 | 3399.0 | 6.1229 | 0.008 089 | 3350.4 | 6.0170 | 0.006 983 | 3301.5 | 5.9179 | 600 |
| 610 | 0.009 740 | 3432.6 | 6.1611 | 0.008 291 | 3386.2 | 6.0577 | 0.007 172 | 3339.5 | 5.9612 | 610 |
| 620 | 0.009 953 | 3465.5 | 6.1981 | 0.008 488 | 3421.1 | 6.0970 | 0.007 357 | 3376.5 | 6.0029 | 620 |
| 630 | 0.010 16 | 3497.8 | 6.2341 | 0.008 681 | 3455.3 | 6.1351 | 0.007 537 | 3412.6 | 6.0431 | 630 |
| 640 | 0.010 37 | 3529.6 | 6.2691 | 0.008 869 | 3488.8 | 6.1720 | 0.007 713 | 3447.9 | 6.0820 | 640 |
| 650 | 0.010 57 | 3560.9 | 6.3032 | 0.009 054 | 3521.8 | 6.2079 | 0.007 885 | 3482.5 | 6.1197 | 650 |
| 660 | 0.010 76 | 3591.8 | 6.3365 | 0.009 235 | 3554.2 | 6.2428 | 0.008 053 | 3516.5 | 6.1562 | 660 |
| 670 | 0.010 96 | 3622.3 | 6.3690 | 0.009 413 | 3586.1 | 6.2768 | 0.008 219 | 3549.9 | 6.1918 | 670 |
| 680 | 0.011 15 | 3652.5 | 6.4008 | 0.009 589 | 3617.6 | 6.3100 | 0.008 381 | 3582.7 | 6.2265 | 680 |
| 690 | 0.011 34 | 3682.3 | 6.4320 | 0.009 761 | 3648.7 | 6.3425 | 0.008 541 | 3615.1 | 6.2602 | 690 |
| 700 | 0.011 52 | 3711.9 | 6.4625 | 0.009 931 | 3679.4 | 6.3743 | 0.008 698 | 3647.0 | 6.2932 | 700 |
| 710 | 0.011 71 | 3741.2 | 6.4925 | 0.010 10 | 3709.8 | 6.4053 | 0.008 853 | 3678.5 | 6.3254 | 710 |
| 720 | 0.011 89 | 3770.3 | 6.5219 | 0.010 26 | 3740.0 | 6.4358 | 0.009 005 | 3709.7 | 6.3570 | 720 |
| 730 | 0.012 07 | 3799.1 | 6.5508 | 0.010 43 | 3769.8 | 6.4657 | 0.009 156 | 3740.5 | 6.3879 | 730 |
| 740 | 0.012 25 | 3827.8 | 6.5793 | 0.010 59 | 3799.4 | 6.4951 | 0.009 304 | 3771.1 | 6.4182 | 740 |
| 750 | 0.012 42 | 3856.3 | 6.6072 | 0.010 75 | 3828.8 | 6.5239 | 0.009 451 | 3801.3 | 6.4479 | 750 |
| 760 | 0.012 60 | 3884.6 | 6.6348 | 0.010 91 | 3857.9 | 6.5523 | 0.009 596 | 3831.4 | 6.4771 | 760 |
| 770 | 0.012 77 | 3912.7 | 6.6619 | 0.011 06 | 3886.9 | 6.5802 | 0.009 739 | 3861.1 | 6.5058 | 770 |
| 780 | 0.012 94 | 3940.8 | 6.6887 | 0.011 22 | 3915.7 | 6.6077 | 0.009 881 | 3890.7 | 6.5340 | 780 |
| 790 | 0.013 11 | 3968.7 | 6.7150 | 0.011 37 | 3944.3 | 6.6347 | 0.010 02 | 3920.1 | 6.5618 | 790 |
| 800 | 0.013 28 | 3996.5 | 6.7411 | 0.011 52 | 3972.8 | 6.6614 | 0.010 16 | 3949.3 | 6.5891 | 800 |

**UNITS:** $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| t (°C) | 50 MPa | | | 55 MPa | | | 60 MPa | | | t (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | v | h | s | v | h | s | v | h | s | |
| 0 | 0.000 976 7 | 49.13 | -0.0010 | 0.000 974 6 | 53.87 | -0.0015 | 0.000 972 5 | 58.59 | -0.0021 | 0 |
| 5 | 0.000 977 3 | 69.27 | 0.0720 | 0.000 975 2 | 73.94 | 0.0713 | 0.000 973 2 | 78.59 | 0.0705 | 5 |
| 10 | 0.000 978 2 | 89.46 | 0.1440 | 0.000 976 1 | 94.07 | 0.1430 | 0.000 974 1 | 98.66 | 0.1420 | 10 |
| 15 | 0.000 979 2 | 109.69 | 0.2148 | 0.000 977 2 | 114.24 | 0.2136 | 0.000 975 2 | 118.78 | 0.2124 | 15 |
| 20 | 0.000 980 5 | 129.96 | 0.2845 | 0.000 978 5 | 134.46 | 0.2832 | 0.000 976 5 | 138.94 | 0.2818 | 20 |
| 25 | 0.000 981 9 | 150.25 | 0.3532 | 0.000 979 9 | 154.70 | 0.3517 | 0.000 978 0 | 159.14 | 0.3501 | 25 |
| 30 | 0.000 983 5 | 170.57 | 0.4208 | 0.000 981 6 | 174.97 | 0.4191 | 0.000 979 6 | 179.36 | 0.4174 | 30 |
| 35 | 0.000 985 2 | 190.91 | 0.4873 | 0.000 983 3 | 195.26 | 0.4855 | 0.000 981 4 | 199.61 | 0.4836 | 35 |
| 40 | 0.000 987 2 | 211.27 | 0.5528 | 0.000 985 2 | 215.58 | 0.5509 | 0.000 983 3 | 219.88 | 0.5489 | 40 |
| 45 | 0.000 989 2 | 231.64 | 0.6174 | 0.000 987 3 | 235.91 | 0.6153 | 0.000 985 4 | 240.17 | 0.6132 | 45 |
| 50 | 0.000 991 4 | 252.03 | 0.6810 | 0.000 989 5 | 256.26 | 0.6787 | 0.000 987 6 | 260.47 | 0.6765 | 50 |
| 55 | 0.000 993 7 | 272.44 | 0.7437 | 0.000 991 8 | 276.62 | 0.7413 | 0.000 989 9 | 280.80 | 0.7389 | 55 |
| 60 | 0.000 996 2 | 292.86 | 0.8054 | 0.000 994 2 | 297.00 | 0.8029 | 0.000 992 3 | 301.13 | 0.8004 | 60 |
| 65 | 0.000 998 7 | 313.30 | 0.8663 | 0.000 996 8 | 317.40 | 0.8637 | 0.000 994 9 | 321.49 | 0.8611 | 65 |
| 70 | 0.001 001 4 | 333.75 | 0.9264 | 0.000 999 5 | 337.81 | 0.9236 | 0.000 997 5 | 341.86 | 0.9209 | 70 |
| 75 | 0.001 004 3 | 354.22 | 0.9856 | 0.001 002 3 | 358.24 | 0.9827 | 0.001 000 3 | 362.25 | 0.9799 | 75 |
| 80 | 0.001 007 2 | 374.71 | 1.0440 | 0.001 005 2 | 378.69 | 1.0410 | 0.001 003 2 | 382.66 | 1.0381 | 80 |
| 85 | 0.001 010 2 | 395.22 | 1.1017 | 0.001 008 2 | 399.16 | 1.0986 | 0.001 006 2 | 403.09 | 1.0955 | 85 |
| 90 | 0.001 013 4 | 415.75 | 1.1586 | 0.001 011 4 | 419.64 | 1.1554 | 0.001 009 3 | 423.54 | 1.1522 | 90 |
| 95 | 0.001 016 7 | 436.30 | 1.2148 | 0.001 014 6 | 440.15 | 1.2115 | 0.001 012 6 | 444.00 | 1.2082 | 95 |
| 100 | 0.001 020 1 | 456.87 | 1.2703 | 0.001 018 0 | 460.68 | 1.2669 | 0.001 015 9 | 464.49 | 1.2634 | 100 |
| 105 | 0.001 023 7 | 477.47 | 1.3251 | 0.001 021 5 | 481.23 | 1.3216 | 0.001 019 4 | 485.00 | 1.3180 | 105 |
| 110 | 0.001 027 3 | 498.09 | 1.3793 | 0.001 025 1 | 501.81 | 1.3756 | 0.001 022 9 | 505.53 | 1.3720 | 110 |
| 115 | 0.001 031 1 | 518.73 | 1.4328 | 0.001 028 8 | 522.41 | 1.4290 | 0.001 026 6 | 526.09 | 1.4253 | 115 |
| 120 | 0.001 034 9 | 539.41 | 1.4858 | 0.001 032 6 | 543.04 | 1.4818 | 0.001 030 4 | 546.67 | 1.4780 | 120 |
| 125 | 0.001 038 9 | 560.11 | 1.5381 | 0.001 036 6 | 563.69 | 1.5341 | 0.001 034 3 | 567.28 | 1.5301 | 125 |
| 130 | 0.001 043 1 | 580.84 | 1.5898 | 0.001 040 7 | 584.37 | 1.5857 | 0.001 038 3 | 587.92 | 1.5816 | 130 |
| 135 | 0.001 047 3 | 601.60 | 1.6410 | 0.001 044 8 | 605.09 | 1.6367 | 0.001 042 4 | 608.58 | 1.6325 | 135 |
| 140 | 0.001 051 7 | 622.40 | 1.6917 | 0.001 049 1 | 625.83 | 1.6873 | 0.001 046 7 | 629.28 | 1.6829 | 140 |
| 145 | 0.001 056 2 | 643.23 | 1.7418 | 0.001 053 6 | 646.61 | 1.7373 | 0.001 051 0 | 650.01 | 1.7328 | 145 |
| 150 | 0.001 060 8 | 664.10 | 1.7914 | 0.001 058 1 | 667.42 | 1.7867 | 0.001 055 5 | 670.77 | 1.7822 | 150 |
| 155 | 0.001 065 5 | 685.00 | 1.8405 | 0.001 062 8 | 688.28 | 1.8357 | 0.001 060 1 | 691.57 | 1.8310 | 155 |
| 160 | 0.001 070 4 | 705.95 | 1.8891 | 0.001 067 6 | 709.17 | 1.8842 | 0.001 064 9 | 712.40 | 1.8794 | 160 |
| 165 | 0.001 075 5 | 726.94 | 1.9373 | 0.001 072 6 | 730.10 | 1.9323 | 0.001 069 8 | 733.27 | 1.9273 | 165 |
| 170 | 0.001 080 6 | 747.98 | 1.9851 | 0.001 077 7 | 751.07 | 1.9799 | 0.001 074 8 | 754.19 | 1.9748 | 170 |
| 175 | 0.001 085 9 | 769.06 | 2.0324 | 0.001 082 9 | 772.09 | 2.0270 | 0.001 079 9 | 775.15 | 2.0218 | 175 |
| 180 | 0.001 091 4 | 790.20 | 2.0793 | 0.001 088 2 | 793.16 | 2.0738 | 0.001 085 2 | 796.15 | 2.0684 | 180 |
| 185 | 0.001 097 0 | 811.39 | 2.1258 | 0.001 093 8 | 814.28 | 2.1201 | 0.001 090 6 | 817.20 | 2.1146 | 185 |
| 190 | 0.001 103 | 832.64 | 2.1719 | 0.001 099 4 | 835.45 | 2.1661 | 0.001 096 1 | 838.31 | 2.1604 | 190 |
| 195 | 0.001 109 | 853.94 | 2.2177 | 0.001 105 | 856.68 | 2.2117 | 0.001 102 | 859.46 | 2.2059 | 195 |
| 200 | 0.001 115 | 875.31 | 2.2631 | 0.001 111 | 877.97 | 2.2569 | 0.001 108 | 880.67 | 2.2509 | 200 |
| 205 | 0.001 121 | 896.75 | 2.3081 | 0.001 117 | 899.33 | 2.3018 | 0.001 114 | 901.95 | 2.2956 | 205 |
| 210 | 0.001 128 | 918.26 | 2.3529 | 0.001 124 | 920.75 | 2.3464 | 0.001 120 | 923.28 | 2.3400 | 210 |
| 215 | 0.001 134 | 939.84 | 2.3973 | 0.001 130 | 942.24 | 2.3906 | 0.001 126 | 944.69 | 2.3841 | 215 |
| 220 | 0.001 141 | 961.50 | 2.4415 | 0.001 137 | 963.80 | 2.4346 | 0.001 133 | 966.16 | 2.4279 | 220 |
| 225 | 0.001 148 | 983.25 | 2.4854 | 0.001 144 | 985.45 | 2.4783 | 0.001 140 | 987.71 | 2.4713 | 225 |
| 230 | 0.001 156 | 1005.1 | 2.5290 | 0.001 151 | 1007.2 | 2.5217 | 0.001 147 | 1009.3 | 2.5145 | 230 |
| 235 | 0.001 163 | 1027.0 | 2.5724 | 0.001 158 | 1029.0 | 2.5648 | 0.001 154 | 1031.0 | 2.5575 | 235 |
| 240 | 0.001 171 | 1049.0 | 2.6155 | 0.001 166 | 1050.9 | 2.6077 | 0.001 161 | 1052.8 | 2.6002 | 240 |
| 245 | 0.001 179 | 1071.2 | 2.6584 | 0.001 174 | 1072.9 | 2.6504 | 0.001 169 | 1074.7 | 2.6426 | 245 |
| 250 | 0.001 187 | 1093.4 | 2.7012 | 0.001 182 | 1095.0 | 2.6929 | 0.001 176 | 1096.7 | 2.6848 | 250 |
| 255 | 0.001 196 | 1115.8 | 2.7437 | 0.001 190 | 1117.2 | 2.7352 | 0.001 184 | 1118.8 | 2.7269 | 255 |
| 260 | 0.001 204 | 1138.3 | 2.7861 | 0.001 198 | 1139.6 | 2.7773 | 0.001 193 | 1141.0 | 2.7687 | 260 |
| 265 | 0.001 214 | 1160.9 | 2.8283 | 0.001 207 | 1162.1 | 2.8192 | 0.001 201 | 1163.3 | 2.8103 | 265 |
| 270 | 0.001 223 | 1183.7 | 2.8704 | 0.001 216 | 1184.6 | 2.8610 | 0.001 210 | 1185.7 | 2.8518 | 270 |

UNITS: $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| t (°C) | 50 MPa | | | 55 MPa | | | 60 MPa | | | t (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | v | h | s | v | h | s | v | h | s | |
| 275 | 0.001 233 | 1206.6 | 2.9124 | 0.001 226 | 1207.4 | 2.9026 | 0.001 219 | 1208.3 | 2.8932 | 275 |
| 280 | 0.001 243 | 1229.7 | 2.9543 | 0.001 236 | 1230.2 | 2.9442 | 0.001 229 | 1231.0 | 2.9344 | 280 |
| 285 | 0.001 254 | 1252.9 | 2.9962 | 0.001 246 | 1253.3 | 2.9856 | 0.001 239 | 1253.8 | 2.9755 | 285 |
| 290 | 0.001 265 | 1276.3 | 3.0379 | 0.001 256 | 1276.5 | 3.0270 | 0.001 249 | 1276.8 | 3.0165 | 290 |
| 295 | 0.001 276 | 1299.9 | 3.0797 | 0.001 267 | 1299.8 | 3.0683 | 0.001 259 | 1299.9 | 3.0574 | 295 |
| 300 | 0.001 288 | 1323.7 | 3.1214 | 0.001 279 | 1323.4 | 3.1095 | 0.001 270 | 1323.3 | 3.0982 | 300 |
| 310 | 0.001 313 | 1372.0 | 3.2049 | 0.001 303 | 1371.0 | 3.1920 | 0.001 293 | 1370.4 | 3.1797 | 310 |
| 320 | 0.001 341 | 1421.2 | 3.2885 | 0.001 329 | 1419.6 | 3.2745 | 0.001 318 | 1418.3 | 3.2612 | 320 |
| 330 | 0.001 371 | 1471.5 | 3.3726 | 0.001 358 | 1469.0 | 3.3572 | 0.001 345 | 1467.0 | 3.3427 | 330 |
| 340 | 0.001 405 | 1523.1 | 3.4574 | 0.001 389 | 1519.6 | 3.4403 | 0.001 374 | 1516.7 | 3.4244 | 340 |
| 350 | 0.001 442 | 1576.0 | 3.5430 | 0.001 424 | 1571.3 | 3.5240 | 0.001 407 | 1567.4 | 3.5064 | 350 |
| 360 | 0.001 485 | 1630.6 | 3.6300 | 0.001 462 | 1624.4 | 3.6086 | 0.001 442 | 1619.3 | 3.5890 | 360 |
| 370 | 0.001 533 | 1687.3 | 3.7189 | 0.001 506 | 1679.3 | 3.6945 | 0.001 482 | 1672.6 | 3.6726 | 370 |
| 380 | 0.001 588 | 1746.5 | 3.8101 | 0.001 555 | 1736.1 | 3.7821 | 0.001 526 | 1727.6 | 3.7573 | 380 |
| 390 | 0.001 654 | 1808.6 | 3.9045 | 0.001 611 | 1795.1 | 3.8718 | 0.001 576 | 1784.3 | 3.8435 | 390 |
| 400 | 0.001 731 | 1874.3 | 4.0028 | 0.001 676 | 1856.9 | 3.9642 | 0.001 633 | 1843.1 | 3.9316 | 400 |
| 410 | 0.001 825 | 1944.5 | 4.1063 | 0.001 753 | 1921.8 | 4.0600 | 0.001 698 | 1904.4 | 4.0219 | 410 |
| 420 | 0.001 940 | 2020.1 | 4.2161 | 0.001 844 | 1990.4 | 4.1597 | 0.001 774 | 1968.4 | 4.1149 | 420 |
| 430 | 0.002 085 | 2102.0 | 4.3334 | 0.001 953 | 2063.4 | 4.2642 | 0.001 861 | 2035.5 | 4.2111 | 430 |
| 440 | 0.002 266 | 2190.5 | 4.4585 | 0.002 084 | 2140.9 | 4.3737 | 0.001 964 | 2106.0 | 4.3106 | 440 |
| 450 | 0.002 487 | 2284.4 | 4.5892 | 0.002 242 | 2222.8 | 4.4877 | 0.002 085 | 2179.8 | 4.4134 | 450 |
| 460 | 0.002 745 | 2380.5 | 4.7212 | 0.002 426 | 2308.1 | 4.6048 | 0.002 224 | 2256.6 | 4.5188 | 460 |
| 470 | 0.003 027 | 2474.7 | 4.8488 | 0.002 636 | 2394.6 | 4.7220 | 0.002 384 | 2335.4 | 4.6256 | 470 |
| 480 | 0.003 319 | 2563.9 | 4.9680 | 0.002 864 | 2480.1 | 4.8363 | 0.002 561 | 2415.0 | 4.7319 | 480 |
| 490 | 0.003 609 | 2646.6 | 5.0770 | 0.003 103 | 2562.5 | 4.9450 | 0.002 752 | 2493.8 | 4.8358 | 490 |
| 500 | 0.003 889 | 2722.5 | 5.1759 | 0.003 344 | 2640.6 | 5.0467 | 0.002 952 | 2570.4 | 4.9356 | 500 |
| 510 | 0.004 160 | 2792.7 | 5.2661 | 0.003 583 | 2713.6 | 5.1405 | 0.003 156 | 2644.0 | 5.0302 | 510 |
| 520 | 0.004 417 | 2857.4 | 5.3482 | 0.003 817 | 2782.2 | 5.2276 | 0.003 361 | 2713.9 | 5.1189 | 520 |
| 530 | 0.004 662 | 2917.2 | 5.4232 | 0.004 043 | 2846.3 | 5.3078 | 0.003 563 | 2780.2 | 5.2020 | 530 |
| 540 | 0.004 896 | 2973.2 | 5.4924 | 0.004 261 | 2906.2 | 5.3820 | 0.003 762 | 2842.9 | 5.2796 | 540 |
| 550 | 0.005 118 | 3025.7 | 5.5566 | 0.004 470 | 2962.5 | 5.4508 | 0.003 955 | 2902.1 | 5.3519 | 550 |
| 560 | 0.005 332 | 3075.4 | 5.6166 | 0.004 671 | 3015.7 | 5.5150 | 0.004 142 | 2958.1 | 5.4195 | 560 |
| 570 | 0.005 537 | 3122.6 | 5.6729 | 0.004 865 | 3066.1 | 5.5752 | 0.004 323 | 3011.3 | 5.4830 | 570 |
| 580 | 0.005 734 | 3167.7 | 5.7261 | 0.005 051 | 3114.1 | 5.6318 | 0.004 499 | 3062.0 | 5.5428 | 580 |
| 590 | 0.005 924 | 3210.9 | 5.7765 | 0.005 231 | 3160.1 | 5.6854 | 0.004 669 | 3110.5 | 5.5993 | 590 |
| 600 | 0.006 109 | 3252.6 | 5.8245 | 0.005 406 | 3204.3 | 5.7363 | 0.004 834 | 3157.0 | 5.6528 | 600 |
| 610 | 0.006 288 | 3292.9 | 5.8705 | 0.005 575 | 3246.8 | 5.7848 | 0.004 993 | 3201.7 | 5.7038 | 610 |
| 620 | 0.006 461 | 3332.0 | 5.9145 | 0.005 739 | 3288.0 | 5.8311 | 0.005 149 | 3244.8 | 5.7524 | 620 |
| 630 | 0.006 631 | 3370.1 | 5.9569 | 0.005 899 | 3328.0 | 5.8756 | 0.005 300 | 3286.7 | 5.7989 | 630 |
| 640 | 0.006 796 | 3407.2 | 5.9977 | 0.006 055 | 3366.9 | 5.9185 | 0.005 447 | 3327.3 | 5.8436 | 640 |
| 650 | 0.006 957 | 3443.5 | 6.0372 | 0.006 207 | 3404.8 | 5.9598 | 0.005 591 | 3366.8 | 5.8867 | 650 |
| 660 | 0.007 115 | 3479.0 | 6.0755 | 0.006 356 | 3441.8 | 5.9997 | 0.005 731 | 3405.3 | 5.9282 | 660 |
| 670 | 0.007 270 | 3513.8 | 6.1126 | 0.006 502 | 3478.1 | 6.0383 | 0.005 869 | 3443.0 | 5.9683 | 670 |
| 680 | 0.007 422 | 3548.0 | 6.1487 | 0.006 644 | 3513.6 | 6.0758 | 0.006 003 | 3479.8 | 6.0072 | 680 |
| 690 | 0.007 571 | 3581.6 | 6.1838 | 0.006 784 | 3548.5 | 6.1122 | 0.006 136 | 3515.9 | 6.0449 | 690 |
| 700 | 0.007 718 | 3614.8 | 6.2180 | 0.006 922 | 3582.8 | 6.1477 | 0.006 265 | 3551.4 | 6.0815 | 700 |
| 710 | 0.007 862 | 3647.4 | 6.2514 | 0.007 057 | 3616.6 | 6.1822 | 0.006 392 | 3586.3 | 6.1172 | 710 |
| 720 | 0.008 004 | 3679.6 | 6.2840 | 0.007 190 | 3649.9 | 6.2159 | 0.006 518 | 3620.6 | 6.1519 | 720 |
| 730 | 0.008 143 | 3711.5 | 6.3159 | 0.007 321 | 3682.7 | 6.2488 | 0.006 641 | 3654.4 | 6.1857 | 730 |
| 740 | 0.008 281 | 3743.0 | 6.3471 | 0.007 450 | 3715.1 | 6.2809 | 0.006 762 | 3687.7 | 6.2188 | 740 |
| 750 | 0.008 417 | 3774.1 | 6.3777 | 0.007 577 | 3747.2 | 6.3124 | 0.006 882 | 3720.6 | 6.2512 | 750 |
| 760 | 0.008 552 | 3805.0 | 6.4078 | 0.007 703 | 3778.9 | 6.3432 | 0.007 000 | 3753.2 | 6.2828 | 760 |
| 770 | 0.008 685 | 3835.6 | 6.4372 | 0.007 827 | 3810.3 | 6.3735 | 0.007 116 | 3785.4 | 6.3138 | 770 |
| 780 | 0.008 816 | 3865.9 | 6.4662 | 0.007 949 | 3841.4 | 6.4032 | 0.007 231 | 3817.3 | 6.3442 | 780 |
| 790 | 0.008 946 | 3896.0 | 6.4946 | 0.008 070 | 3872.3 | 6.4323 | 0.007 345 | 3848.8 | 6.3741 | 790 |
| 800 | 0.009 074 | 3926.0 | 6.5226 | 0.008 190 | 3902.9 | 6.4610 | 0.007 457 | 3880.2 | 6.4034 | 800 |

**UNITS**: $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 65 MPa | | | 70 MPa | | | 75 MPa | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *t* (°C) | *v* | *h* | *s* | *v* | *h* | *s* | *v* | *h* | *s* | *t* (°C) |
| 0 | 0.000 970 4 | 63.27 | -0.0027 | 0.000 968 3 | 67.93 | -0.0034 | 0.000 966 3 | 72.57 | -0.0041 | 0 |
| 5 | 0.000 971 2 | 83.22 | 0.0696 | 0.000 969 2 | 87.82 | 0.0688 | 0.000 967 2 | 92.40 | 0.0678 | 5 |
| 10 | 0.000 972 1 | 103.23 | 0.1410 | 0.000 970 2 | 107.77 | 0.1399 | 0.000 968 2 | 112.30 | 0.1387 | 10 |
| 15 | 0.000 973 3 | 123.29 | 0.2112 | 0.000 971 4 | 127.79 | 0.2099 | 0.000 969 5 | 132.27 | 0.2086 | 15 |
| 20 | 0.000 974 6 | 143.41 | 0.2804 | 0.000 972 7 | 147.86 | 0.2790 | 0.000 970 9 | 152.29 | 0.2775 | 20 |
| 25 | 0.000 976 1 | 163.55 | 0.3486 | 0.000 974 2 | 167.96 | 0.3470 | 0.000 972 4 | 172.35 | 0.3454 | 25 |
| 30 | 0.000 977 8 | 183.73 | 0.4157 | 0.000 975 9 | 188.10 | 0.4140 | 0.000 974 1 | 192.44 | 0.4122 | 30 |
| 35 | 0.000 979 6 | 203.94 | 0.4818 | 0.000 977 7 | 208.26 | 0.4799 | 0.000 975 9 | 212.57 | 0.4781 | 35 |
| 40 | 0.000 981 5 | 224.17 | 0.5469 | 0.000 979 6 | 228.45 | 0.5449 | 0.000 977 8 | 232.72 | 0.5429 | 40 |
| 45 | 0.000 983 5 | 244.41 | 0.6110 | 0.000 981 7 | 248.65 | 0.6089 | 0.000 979 9 | 252.88 | 0.6068 | 45 |
| 50 | 0.000 985 7 | 264.68 | 0.6742 | 0.000 983 9 | 268.88 | 0.6720 | 0.000 982 0 | 273.07 | 0.6698 | 50 |
| 55 | 0.000 988 0 | 284.96 | 0.7365 | 0.000 986 2 | 289.13 | 0.7342 | 0.000 984 3 | 293.28 | 0.7318 | 55 |
| 60 | 0.000 990 4 | 305.26 | 0.7979 | 0.000 988 6 | 309.39 | 0.7955 | 0.000 986 7 | 313.50 | 0.7930 | 60 |
| 65 | 0.000 993 0 | 325.58 | 0.8585 | 0.000 991 1 | 329.67 | 0.8559 | 0.000 989 3 | 333.75 | 0.8533 | 65 |
| 70 | 0.000 995 6 | 345.91 | 0.9182 | 0.000 993 7 | 349.96 | 0.9155 | 0.000 991 9 | 354.00 | 0.9128 | 70 |
| 75 | 0.000 998 4 | 366.27 | 0.9770 | 0.000 996 5 | 370.28 | 0.9742 | 0.000 994 6 | 374.28 | 0.9714 | 75 |
| 80 | 0.001 001 3 | 386.64 | 1.0351 | 0.000 999 3 | 390.61 | 1.0322 | 0.000 997 4 | 394.57 | 1.0293 | 80 |
| 85 | 0.001 004 2 | 407.02 | 1.0925 | 0.001 002 3 | 410.96 | 1.0894 | 0.001 000 4 | 414.89 | 1.0864 | 85 |
| 90 | 0.001 007 3 | 427.43 | 1.1490 | 0.001 005 4 | 431.32 | 1.1459 | 0.001 003 4 | 435.22 | 1.1428 | 90 |
| 95 | 0.001 010 5 | 447.86 | 1.2049 | 0.001 008 5 | 451.71 | 1.2017 | 0.001 006 6 | 455.57 | 1.1984 | 95 |
| 100 | 0.001 013 8 | 468.30 | 1.2601 | 0.001 011 8 | 472.12 | 1.2567 | 0.001 009 8 | 475.94 | 1.2534 | 100 |
| 105 | 0.001 017 3 | 488.77 | 1.3146 | 0.001 015 2 | 492.55 | 1.3111 | 0.001 013 2 | 496.32 | 1.3077 | 105 |
| 110 | 0.001 020 8 | 509.26 | 1.3684 | 0.001 018 7 | 513.00 | 1.3648 | 0.001 016 6 | 516.74 | 1.3613 | 110 |
| 115 | 0.001 024 4 | 529.78 | 1.4216 | 0.001 022 3 | 533.47 | 1.4179 | 0.001 020 2 | 537.17 | 1.4143 | 115 |
| 120 | 0.001 028 2 | 550.32 | 1.4742 | 0.001 026 0 | 553.97 | 1.4704 | 0.001 023 8 | 557.62 | 1.4667 | 120 |
| 125 | 0.001 032 0 | 570.88 | 1.5261 | 0.001 029 8 | 574.49 | 1.5223 | 0.001 027 6 | 578.10 | 1.5184 | 125 |
| 130 | 0.001 036 0 | 591.47 | 1.5775 | 0.001 033 7 | 595.04 | 1.5735 | 0.001 031 5 | 598.61 | 1.5696 | 130 |
| 135 | 0.001 040 1 | 612.09 | 1.6284 | 0.001 037 7 | 615.61 | 1.6243 | 0.001 035 5 | 619.14 | 1.6202 | 135 |
| 140 | 0.001 044 3 | 632.74 | 1.6786 | 0.001 041 9 | 636.21 | 1.6744 | 0.001 039 5 | 639.69 | 1.6703 | 140 |
| 145 | 0.001 048 6 | 653.42 | 1.7284 | 0.001 046 1 | 656.84 | 1.7241 | 0.001 043 7 | 660.28 | 1.7198 | 145 |
| 150 | 0.001 053 0 | 674.13 | 1.7776 | 0.001 050 5 | 677.50 | 1.7732 | 0.001 048 0 | 680.89 | 1.7688 | 150 |
| 155 | 0.001 057 5 | 694.87 | 1.8264 | 0.001 055 0 | 698.20 | 1.8218 | 0.001 052 5 | 701.54 | 1.8173 | 155 |
| 160 | 0.001 062 2 | 715.65 | 1.8746 | 0.001 059 6 | 718.93 | 1.8699 | 0.001 057 0 | 722.21 | 1.8653 | 160 |
| 165 | 0.001 067 0 | 736.47 | 1.9224 | 0.001 064 3 | 739.69 | 1.9176 | 0.001 061 6 | 742.92 | 1.9128 | 165 |
| 170 | 0.001 071 9 | 757.33 | 1.9697 | 0.001 069 1 | 760.49 | 1.9648 | 0.001 066 4 | 763.67 | 1.9599 | 170 |
| 175 | 0.001 077 0 | 778.23 | 2.0166 | 0.001 074 1 | 781.33 | 2.0116 | 0.001 071 3 | 784.45 | 2.0066 | 175 |
| 180 | 0.001 082 1 | 799.17 | 2.0631 | 0.001 079 2 | 802.21 | 2.0579 | 0.001 076 3 | 805.28 | 2.0528 | 180 |
| 185 | 0.001 087 5 | 820.15 | 2.1092 | 0.001 084 4 | 823.14 | 2.1038 | 0.001 081 5 | 826.14 | 2.0986 | 185 |
| 190 | 0.001 092 9 | 841.19 | 2.1548 | 0.001 089 8 | 844.11 | 2.1493 | 0.001 086 8 | 847.05 | 2.1440 | 190 |
| 195 | 0.001 098 5 | 862.28 | 2.2001 | 0.001 095 3 | 865.12 | 2.1945 | 0.001 092 2 | 868.00 | 2.1890 | 195 |
| 200 | 0.001 104 | 883.42 | 2.2450 | 0.001 101 | 886.19 | 2.2392 | 0.001 097 7 | 889.01 | 2.2336 | 200 |
| 205 | 0.001 110 | 904.61 | 2.2896 | 0.001 107 | 907.32 | 2.2837 | 0.001 103 | 910.06 | 2.2778 | 205 |
| 210 | 0.001 116 | 925.87 | 2.3338 | 0.001 113 | 928.50 | 2.3277 | 0.001 109 | 931.16 | 2.3217 | 210 |
| 215 | 0.001 123 | 947.19 | 2.3777 | 0.001 119 | 949.74 | 2.3715 | 0.001 115 | 952.33 | 2.3653 | 215 |
| 220 | 0.001 129 | 968.57 | 2.4213 | 0.001 125 | 971.04 | 2.4149 | 0.001 121 | 973.55 | 2.4086 | 220 |
| 225 | 0.001 136 | 990.03 | 2.4646 | 0.001 132 | 992.40 | 2.4580 | 0.001 128 | 994.83 | 2.4515 | 225 |
| 230 | 0.001 142 | 1011.6 | 2.5076 | 0.001 138 | 1013.8 | 2.5008 | 0.001 134 | 1016.2 | 2.4942 | 230 |
| 235 | 0.001 149 | 1033.2 | 2.5503 | 0.001 145 | 1035.4 | 2.5433 | 0.001 141 | 1037.6 | 2.5365 | 235 |
| 240 | 0.001 156 | 1054.9 | 2.5928 | 0.001 152 | 1056.9 | 2.5856 | 0.001 148 | 1059.1 | 2.5786 | 240 |
| 245 | 0.001 164 | 1076.6 | 2.6350 | 0.001 159 | 1078.6 | 2.6276 | 0.001 155 | 1080.7 | 2.6204 | 245 |
| 250 | 0.001 171 | 1098.5 | 2.6770 | 0.001 167 | 1100.4 | 2.6694 | 0.001 162 | 1102.3 | 2.6620 | 250 |
| 255 | 0.001 179 | 1120.5 | 2.7188 | 0.001 174 | 1122.2 | 2.7110 | 0.001 169 | 1124.0 | 2.7034 | 255 |
| 260 | 0.001 187 | 1142.5 | 2.7604 | 0.001 182 | 1144.1 | 2.7523 | 0.001 177 | 1145.9 | 2.7445 | 260 |
| 265 | 0.001 196 | 1164.7 | 2.8018 | 0.001 190 | 1166.2 | 2.7935 | 0.001 185 | 1167.8 | 2.7854 | 265 |
| 270 | 0.001 204 | 1187.0 | 2.8430 | 0.001 198 | 1188.3 | 2.8344 | 0.001 193 | 1189.8 | 2.8261 | 270 |

**UNITS**: *v* in $m^3/kg$ ; *h* in kJ/kg ; *s* in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| t (°C) | 65 MPa | | | 70 MPa | | | 75 MPa | | | t (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | v | h | s | v | h | s | v | h | s | |
| 275 | 0.001 213 | 1209.4 | 2.8840 | 0.001 207 | 1210.6 | 2.8752 | 0.001 201 | 1211.9 | 2.8666 | 275 |
| 280 | 0.001 222 | 1231.9 | 2.9250 | 0.001 216 | 1232.9 | 2.9158 | 0.001 210 | 1234.1 | 2.9070 | 280 |
| 285 | 0.001 232 | 1254.6 | 2.9657 | 0.001 225 | 1255.4 | 2.9563 | 0.001 219 | 1256.5 | 2.9472 | 285 |
| 290 | 0.001 241 | 1277.3 | 3.0064 | 0.001 234 | 1278.1 | 2.9966 | 0.001 228 | 1278.9 | 2.9872 | 290 |
| 295 | 0.001 251 | 1300.3 | 3.0469 | 0.001 244 | 1300.8 | 3.0368 | 0.001 237 | 1301.5 | 3.0271 | 295 |
| 300 | 0.001 262 | 1323.4 | 3.0874 | 0.001 254 | 1323.7 | 3.0769 | 0.001 247 | 1324.2 | 3.0669 | 300 |
| 310 | 0.001 284 | 1370.0 | 3.1681 | 0.001 275 | 1369.9 | 3.1569 | 0.001 267 | 1370.0 | 3.1461 | 310 |
| 320 | 0.001 308 | 1417.4 | 3.2486 | 0.001 298 | 1416.7 | 3.2365 | 0.001 289 | 1416.4 | 3.2250 | 320 |
| 330 | 0.001 333 | 1465.5 | 3.3290 | 0.001 322 | 1464.3 | 3.3160 | 0.001 312 | 1463.4 | 3.3036 | 330 |
| 340 | 0.001 361 | 1514.4 | 3.4094 | 0.001 349 | 1512.5 | 3.3953 | 0.001 337 | 1511.0 | 3.3820 | 340 |
| 350 | 0.001 391 | 1564.2 | 3.4900 | 0.001 377 | 1561.6 | 3.4747 | 0.001 364 | 1559.4 | 3.4602 | 350 |
| 360 | 0.001 424 | 1615.0 | 3.5709 | 0.001 408 | 1611.5 | 3.5541 | 0.001 394 | 1608.5 | 3.5384 | 360 |
| 370 | 0.001 461 | 1667.1 | 3.6525 | 0.001 442 | 1662.5 | 3.6341 | 0.001 425 | 1658.6 | 3.6169 | 370 |
| 380 | 0.001 501 | 1720.5 | 3.7350 | 0.001 480 | 1714.7 | 3.7146 | 0.001 460 | 1709.7 | 3.6958 | 380 |
| 390 | 0.001 547 | 1775.5 | 3.8184 | 0.001 521 | 1768.1 | 3.7957 | 0.001 498 | 1761.9 | 3.7750 | 390 |
| 400 | 0.001 597 | 1832.1 | 3.9031 | 0.001 566 | 1822.9 | 3.8778 | 0.001 540 | 1815.2 | 3.8548 | 400 |
| 410 | 0.001 654 | 1890.5 | 3.9894 | 0.001 617 | 1879.2 | 3.9609 | 0.001 586 | 1869.9 | 3.9354 | 410 |
| 420 | 0.001 719 | 1951.2 | 4.0775 | 0.001 674 | 1937.3 | 4.0453 | 0.001 637 | 1925.9 | 4.0168 | 420 |
| 430 | 0.001 793 | 2014.3 | 4.1678 | 0.001 738 | 1997.3 | 4.1312 | 0.001 693 | 1983.5 | 4.0994 | 430 |
| 440 | 0.001 877 | 2079.8 | 4.2604 | 0.001 810 | 2059.3 | 4.2188 | 0.001 757 | 2042.8 | 4.1830 | 440 |
| 450 | 0.001 975 | 2148.0 | 4.3554 | 0.001 892 | 2123.4 | 4.3080 | 0.001 827 | 2103.7 | 4.2679 | 450 |
| 460 | 0.002 086 | 2218.6 | 4.4524 | 0.001 984 | 2189.5 | 4.3987 | 0.001 906 | 2166.3 | 4.3539 | 460 |
| 470 | 0.002 212 | 2291.3 | 4.5507 | 0.002 087 | 2257.3 | 4.4906 | 0.001 993 | 2230.4 | 4.4407 | 470 |
| 480 | 0.002 352 | 2365.1 | 4.6495 | 0.002 202 | 2326.4 | 4.5830 | 0.002 089 | 2295.7 | 4.5280 | 480 |
| 490 | 0.002 505 | 2439.3 | 4.7473 | 0.002 327 | 2396.3 | 4.6752 | 0.002 194 | 2361.9 | 4.6153 | 490 |
| 500 | 0.002 669 | 2512.8 | 4.8430 | 0.002 463 | 2466.2 | 4.7662 | 0.002 308 | 2428.5 | 4.7019 | 500 |
| 510 | 0.002 841 | 2584.7 | 4.9354 | 0.002 607 | 2535.5 | 4.8552 | 0.002 430 | 2494.9 | 4.7873 | 510 |
| 520 | 0.003 017 | 2654.3 | 5.0236 | 0.002 757 | 2603.4 | 4.9413 | 0.002 558 | 2560.6 | 4.8707 | 520 |
| 530 | 0.003 194 | 2721.1 | 5.1073 | 0.002 911 | 2669.5 | 5.0242 | 0.002 691 | 2625.2 | 4.9517 | 530 |
| 540 | 0.003 372 | 2785.0 | 5.1864 | 0.003 067 | 2733.4 | 5.1032 | 0.002 827 | 2688.3 | 5.0298 | 540 |
| 550 | 0.003 547 | 2845.9 | 5.2609 | 0.003 223 | 2795.0 | 5.1786 | 0.002 966 | 2749.6 | 5.1047 | 550 |
| 560 | 0.003 718 | 2903.9 | 5.3309 | 0.003 378 | 2854.1 | 5.2499 | 0.003 105 | 2809.1 | 5.1765 | 560 |
| 570 | 0.003 886 | 2959.2 | 5.3970 | 0.003 532 | 2910.7 | 5.3175 | 0.003 244 | 2866.4 | 5.2448 | 570 |
| 580 | 0.004 050 | 3012.1 | 5.4593 | 0.003 683 | 2965.1 | 5.3816 | 0.003 382 | 2921.6 | 5.3100 | 580 |
| 590 | 0.004 209 | 3062.7 | 5.5182 | 0.003 830 | 3017.3 | 5.4424 | 0.003 518 | 2974.9 | 5.3721 | 590 |
| 600 | 0.004 363 | 3111.2 | 5.5741 | 0.003 975 | 3067.5 | 5.5003 | 0.003 652 | 3026.4 | 5.4313 | 600 |
| 610 | 0.004 514 | 3157.9 | 5.6273 | 0.004 116 | 3115.8 | 5.5553 | 0.003 784 | 3076.0 | 5.4878 | 610 |
| 620 | 0.004 660 | 3202.9 | 5.6779 | 0.004 254 | 3162.4 | 5.6078 | 0.003 913 | 3123.9 | 5.5418 | 620 |
| 630 | 0.004 803 | 3246.4 | 5.7264 | 0.004 388 | 3207.5 | 5.6579 | 0.004 039 | 3170.3 | 5.5934 | 630 |
| 640 | 0.004 942 | 3288.6 | 5.7729 | 0.004 520 | 3251.2 | 5.7060 | 0.004 163 | 3215.2 | 5.6429 | 640 |
| 650 | 0.005 078 | 3329.6 | 5.8176 | 0.004 648 | 3293.6 | 5.7522 | 0.004 285 | 3258.9 | 5.6904 | 650 |
| 660 | 0.005 211 | 3369.6 | 5.8606 | 0.004 774 | 3334.8 | 5.7967 | 0.004 403 | 3301.3 | 5.7362 | 660 |
| 670 | 0.005 341 | 3408.6 | 5.9022 | 0.004 897 | 3375.1 | 5.8396 | 0.004 520 | 3342.7 | 5.7803 | 670 |
| 680 | 0.005 469 | 3446.7 | 5.9424 | 0.005 018 | 3414.4 | 5.8810 | 0.004 634 | 3383.1 | 5.8229 | 680 |
| 690 | 0.005 594 | 3484.0 | 5.9813 | 0.005 136 | 3452.8 | 5.9211 | 0.004 746 | 3422.6 | 5.8641 | 690 |
| 700 | 0.005 716 | 3520.6 | 6.0191 | 0.005 252 | 3490.5 | 5.9600 | 0.004 856 | 3461.2 | 5.9040 | 700 |
| 710 | 0.005 836 | 3556.5 | 6.0558 | 0.005 366 | 3527.4 | 5.9978 | 0.004 964 | 3499.1 | 5.9427 | 710 |
| 720 | 0.005 955 | 3591.8 | 6.0915 | 0.005 478 | 3563.6 | 6.0344 | 0.005 071 | 3536.2 | 5.9803 | 720 |
| 730 | 0.006 071 | 3626.5 | 6.1263 | 0.005 588 | 3599.3 | 6.0702 | 0.005 175 | 3572.7 | 6.0169 | 730 |
| 740 | 0.006 186 | 3660.8 | 6.1603 | 0.005 697 | 3634.4 | 6.1050 | 0.005 278 | 3608.6 | 6.0525 | 740 |
| 750 | 0.006 299 | 3694.5 | 6.1935 | 0.005 804 | 3669.0 | 6.1390 | 0.005 380 | 3644.0 | 6.0873 | 750 |
| 760 | 0.006 410 | 3727.9 | 6.2259 | 0.005 909 | 3703.1 | 6.1722 | 0.005 480 | 3678.9 | 6.1212 | 760 |
| 770 | 0.006 520 | 3760.9 | 6.2577 | 0.006 013 | 3736.8 | 6.2046 | 0.005 578 | 3713.3 | 6.1544 | 770 |
| 780 | 0.006 628 | 3793.5 | 6.2888 | 0.006 115 | 3770.1 | 6.2364 | 0.005 676 | 3747.3 | 6.1868 | 780 |
| 790 | 0.006 735 | 3825.8 | 6.3193 | 0.006 217 | 3803.1 | 6.2676 | 0.005 772 | 3781.0 | 6.2186 | 790 |
| 800 | 0.006 841 | 3857.8 | 6.3493 | 0.006 317 | 3835.8 | 6.2982 | 0.005 866 | 3814.3 | 6.2498 | 800 |

**UNITS:** $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| | 80 MPa | | | 90 MPa | | | 100 MPa | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *t* (°C) | *v* | *h* | *s* | *v* | *h* | *s* | *v* | *h* | *s* | *t* (°C) |
| **0** | 0.000 964 3 | 77.18 | -0.0049 | 0.000 960 5 | 86.33 | -0.0066 | 0.000 956 7 | 95.39 | -0.0086 | **0** |
| **5** | 0.000 965 3 | 96.95 | 0.0668 | 0.000 961 5 | 106.00 | 0.0647 | 0.000 957 8 | 114.97 | 0.0625 | **5** |
| **10** | 0.000 966 3 | 116.81 | 0.1376 | 0.000 962 6 | 125.77 | 0.1352 | 0.000 959 0 | 134.65 | 0.1326 | **10** |
| **15** | 0.000 967 6 | 136.73 | 0.2073 | 0.000 963 9 | 145.60 | 0.2046 | 0.000 960 4 | 154.41 | 0.2018 | **15** |
| **20** | 0.000 969 0 | 156.71 | 0.2761 | 0.000 965 4 | 165.50 | 0.2730 | 0.000 961 9 | 174.23 | 0.2700 | **20** |
| **25** | 0.000 970 6 | 176.73 | 0.3438 | 0.000 967 0 | 185.44 | 0.3405 | 0.000 963 5 | 194.10 | 0.3372 | **25** |
| **30** | 0.000 972 3 | 196.78 | 0.4105 | 0.000 968 7 | 205.42 | 0.4069 | 0.000 965 2 | 214.00 | 0.4034 | **30** |
| **35** | 0.000 974 1 | 216.86 | 0.4762 | 0.000 970 5 | 225.43 | 0.4724 | 0.000 967 1 | 233.94 | 0.4686 | **35** |
| **40** | 0.000 976 0 | 236.97 | 0.5409 | 0.000 972 5 | 245.46 | 0.5369 | 0.000 969 1 | 253.91 | 0.5329 | **40** |
| **45** | 0.000 978 1 | 257.11 | 0.6047 | 0.000 974 6 | 265.52 | 0.6005 | 0.000 971 1 | 273.90 | 0.5962 | **45** |
| **50** | 0.000 980 2 | 277.26 | 0.6675 | 0.000 976 7 | 285.60 | 0.6631 | 0.000 973 3 | 293.92 | 0.6586 | **50** |
| **55** | 0.000 982 5 | 297.43 | 0.7295 | 0.000 979 0 | 305.70 | 0.7248 | 0.000 975 6 | 313.95 | 0.7202 | **55** |
| **60** | 0.000 984 9 | 317.62 | 0.7905 | 0.000 981 4 | 325.82 | 0.7857 | 0.000 977 9 | 334.00 | 0.7808 | **60** |
| **65** | 0.000 987 4 | 337.82 | 0.8507 | 0.000 983 9 | 345.96 | 0.8456 | 0.000 980 4 | 354.07 | 0.8406 | **65** |
| **70** | 0.000 990 0 | 358.04 | 0.9101 | 0.000 986 5 | 366.11 | 0.9048 | 0.000 983 0 | 374.16 | 0.8996 | **70** |
| **75** | 0.000 992 8 | 378.28 | 0.9687 | 0.000 989 1 | 386.28 | 0.9632 | 0.000 985 6 | 394.26 | 0.9577 | **75** |
| **80** | 0.000 995 6 | 398.54 | 1.0264 | 0.000 991 9 | 406.47 | 1.0207 | 0.000 988 3 | 414.38 | 1.0151 | **80** |
| **85** | 0.000 998 5 | 418.82 | 1.0834 | 0.000 994 8 | 426.67 | 1.0776 | 0.000 991 2 | 434.52 | 1.0717 | **85** |
| **90** | 0.001 001 5 | 439.11 | 1.1397 | 0.000 997 8 | 446.90 | 1.1336 | 0.000 994 1 | 454.68 | 1.1276 | **90** |
| **95** | 0.001 004 6 | 459.42 | 1.1953 | 0.001 000 8 | 467.14 | 1.1890 | 0.000 997 1 | 474.85 | 1.1828 | **95** |
| **100** | 0.001 007 8 | 479.75 | 1.2501 | 0.001 004 0 | 487.39 | 1.2436 | 0.001 000 2 | 495.04 | 1.2373 | **100** |
| **105** | 0.001 011 2 | 500.11 | 1.3043 | 0.001 007 3 | 507.67 | 1.2976 | 0.001 003 4 | 515.25 | 1.2911 | **105** |
| **110** | 0.001 014 6 | 520.48 | 1.3578 | 0.001 010 6 | 527.97 | 1.3509 | 0.001 006 7 | 535.47 | 1.3442 | **110** |
| **115** | 0.001 018 1 | 540.87 | 1.4107 | 0.001 014 1 | 548.29 | 1.4036 | 0.001 010 1 | 555.72 | 1.3967 | **115** |
| **120** | 0.001 021 7 | 561.29 | 1.4630 | 0.001 017 6 | 568.62 | 1.4557 | 0.001 013 6 | 575.98 | 1.4486 | **120** |
| **125** | 0.001 025 5 | 581.72 | 1.5146 | 0.001 021 2 | 588.98 | 1.5071 | 0.001 017 2 | 596.27 | 1.4998 | **125** |
| **130** | 0.001 029 3 | 602.19 | 1.5657 | 0.001 025 0 | 609.37 | 1.5580 | 0.001 020 8 | 616.57 | 1.5505 | **130** |
| **135** | 0.001 033 2 | 622.67 | 1.6162 | 0.001 028 8 | 629.77 | 1.6083 | 0.001 024 6 | 636.90 | 1.6006 | **135** |
| **140** | 0.001 037 2 | 643.19 | 1.6661 | 0.001 032 8 | 650.20 | 1.6581 | 0.001 028 4 | 657.24 | 1.6502 | **140** |
| **145** | 0.001 041 4 | 663.72 | 1.7156 | 0.001 036 8 | 670.65 | 1.7073 | 0.001 032 4 | 677.62 | 1.6992 | **145** |
| **150** | 0.001 045 6 | 684.29 | 1.7645 | 0.001 041 0 | 691.13 | 1.7560 | 0.001 036 4 | 698.01 | 1.7477 | **150** |
| **155** | 0.001 050 0 | 704.89 | 1.8128 | 0.001 045 2 | 711.63 | 1.8041 | 0.001 040 6 | 718.43 | 1.7956 | **155** |
| **160** | 0.001 054 5 | 725.52 | 1.8607 | 0.001 049 6 | 732.17 | 1.8518 | 0.001 044 8 | 738.87 | 1.8431 | **160** |
| **165** | 0.001 059 1 | 746.18 | 1.9082 | 0.001 054 0 | 752.73 | 1.8990 | 0.001 049 2 | 759.34 | 1.8901 | **165** |
| **170** | 0.001 063 8 | 766.87 | 1.9551 | 0.001 058 6 | 773.33 | 1.9458 | 0.001 053 6 | 779.84 | 1.9366 | **170** |
| **175** | 0.001 068 6 | 787.60 | 2.0016 | 0.001 063 3 | 793.95 | 1.9920 | 0.001 058 2 | 800.37 | 1.9827 | **175** |
| **180** | 0.001 073 5 | 808.37 | 2.0477 | 0.001 068 1 | 814.61 | 2.0379 | 0.001 062 8 | 820.93 | 2.0283 | **180** |
| **185** | 0.001 078 6 | 829.17 | 2.0934 | 0.001 073 0 | 835.31 | 2.0833 | 0.001 067 6 | 841.53 | 2.0735 | **185** |
| **190** | 0.001 083 8 | 850.02 | 2.1387 | 0.001 078 0 | 856.04 | 2.1283 | 0.001 072 5 | 862.15 | 2.1183 | **190** |
| **195** | 0.001 089 1 | 870.91 | 2.1835 | 0.001 083 1 | 876.81 | 2.1729 | 0.001 077 5 | 882.81 | 2.1627 | **195** |
| **200** | 0.001 094 5 | 891.85 | 2.2280 | 0.001 088 4 | 897.63 | 2.2171 | 0.001 082 6 | 903.51 | 2.2066 | **200** |
| **205** | 0.001 100 | 912.83 | 2.2721 | 0.001 093 8 | 918.48 | 2.2610 | 0.001 087 8 | 924.25 | 2.2502 | **205** |
| **210** | 0.001 106 | 933.87 | 2.3159 | 0.001 099 3 | 939.39 | 2.3045 | 0.001 093 1 | 945.03 | 2.2935 | **210** |
| **215** | 0.001 112 | 954.96 | 2.3593 | 0.001 105 | 960.34 | 2.3476 | 0.001 098 6 | 965.86 | 2.3364 | **215** |
| **220** | 0.001 118 | 976.10 | 2.4024 | 0.001 111 | 981.34 | 2.3904 | 0.001 104 | 986.72 | 2.3789 | **220** |
| **225** | 0.001 124 | 997.31 | 2.4452 | 0.001 117 | 1002.4 | 2.4329 | 0.001 110 | 1007.6 | 2.4211 | **225** |
| **230** | 0.001 130 | 1018.6 | 2.4877 | 0.001 123 | 1023.5 | 2.4751 | 0.001 116 | 1028.6 | 2.4630 | **230** |
| **235** | 0.001 137 | 1039.9 | 2.5299 | 0.001 129 | 1044.7 | 2.5169 | 0.001 122 | 1049.6 | 2.5045 | **235** |
| **240** | 0.001 143 | 1061.3 | 2.5718 | 0.001 136 | 1065.9 | 2.5585 | 0.001 128 | 1070.7 | 2.5458 | **240** |
| **245** | 0.001 150 | 1082.8 | 2.6134 | 0.001 142 | 1087.2 | 2.5998 | 0.001 134 | 1091.8 | 2.5868 | **245** |
| **250** | 0.001 157 | 1104.3 | 2.6548 | 0.001 149 | 1108.6 | 2.6408 | 0.001 141 | 1113.0 | 2.6275 | **250** |
| **255** | 0.001 165 | 1126.0 | 2.6959 | 0.001 156 | 1130.0 | 2.6816 | 0.001 147 | 1134.3 | 2.6679 | **255** |
| **260** | 0.001 172 | 1147.7 | 2.7368 | 0.001 163 | 1151.5 | 2.7221 | 0.001 154 | 1155.6 | 2.7081 | **260** |
| **265** | 0.001 180 | 1169.5 | 2.7775 | 0.001 170 | 1173.1 | 2.7624 | 0.001 161 | 1177.0 | 2.7481 | **265** |
| **270** | 0.001 188 | 1191.4 | 2.8180 | 0.001 178 | 1194.7 | 2.8025 | 0.001 168 | 1198.5 | 2.7878 | **270** |

**UNITS:** *v* in $m^3$/kg ; *h* in kJ/kg ; *s* in kJ/(kg·K)

## Table T-3. Properties of Superheated Steam and Compressed Water (cont'd)

| t (°C) | 80 MPa | | | 90 MPa | | | 100 MPa | | | t (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | v | h | s | v | h | s | v | h | s | |
| 275 | 0.001 196 | 1213.3 | 2.8583 | 0.001 185 | 1216.5 | 2.8424 | 0.001 175 | 1220.0 | 2.8272 | 275 |
| 280 | 0.001 204 | 1235.4 | 2.8984 | 0.001 193 | 1238.3 | 2.8820 | 0.001 183 | 1241.6 | 2.8665 | 280 |
| 285 | 0.001 213 | 1257.6 | 2.9384 | 0.001 201 | 1260.3 | 2.9215 | 0.001 191 | 1263.3 | 2.9055 | 285 |
| 290 | 0.001 221 | 1279.9 | 2.9781 | 0.001 209 | 1282.3 | 2.9608 | 0.001 198 | 1285.1 | 2.9444 | 290 |
| 295 | 0.001 230 | 1302.3 | 3.0178 | 0.001 218 | 1304.4 | 2.9999 | 0.001 207 | 1307.0 | 2.9830 | 295 |
| 300 | 0.001 240 | 1324.9 | 3.0572 | 0.001 227 | 1326.6 | 3.0388 | 0.001 215 | 1328.9 | 3.0215 | 300 |
| 310 | 0.001 259 | 1370.3 | 3.1358 | 0.001 245 | 1371.4 | 3.1163 | 0.001 232 | 1373.1 | 3.0980 | 310 |
| 320 | 0.001 280 | 1416.3 | 3.2140 | 0.001 265 | 1416.6 | 3.1931 | 0.001 250 | 1417.7 | 3.1738 | 320 |
| 330 | 0.001 303 | 1462.8 | 3.2918 | 0.001 285 | 1462.3 | 3.2695 | 0.001 270 | 1462.7 | 3.2490 | 330 |
| 340 | 0.001 327 | 1509.9 | 3.3693 | 0.001 307 | 1508.5 | 3.3455 | 0.001 290 | 1508.1 | 3.3236 | 340 |
| 350 | 0.001 352 | 1557.7 | 3.4465 | 0.001 331 | 1555.2 | 3.4211 | 0.001 312 | 1553.9 | 3.3978 | 350 |
| 360 | 0.001 380 | 1606.1 | 3.5236 | 0.001 356 | 1602.5 | 3.4963 | 0.001 335 | 1600.2 | 3.4715 | 360 |
| 370 | 0.001 410 | 1655.4 | 3.6008 | 0.001 383 | 1650.4 | 3.5714 | 0.001 359 | 1647.1 | 3.5449 | 370 |
| 380 | 0.001 443 | 1705.6 | 3.6783 | 0.001 412 | 1699.1 | 3.6465 | 0.001 385 | 1694.5 | 3.6181 | 380 |
| 390 | 0.001 478 | 1756.7 | 3.7559 | 0.001 443 | 1748.4 | 3.7215 | 0.001 413 | 1742.5 | 3.6910 | 390 |
| 400 | 0.001 516 | 1808.8 | 3.8339 | 0.001 476 | 1798.6 | 3.7965 | 0.001 443 | 1791.1 | 3.7638 | 400 |
| 410 | 0.001 558 | 1861.9 | 3.9123 | 0.001 513 | 1849.5 | 3.8716 | 0.001 475 | 1840.4 | 3.8364 | 410 |
| 420 | 0.001 605 | 1916.3 | 3.9913 | 0.001 552 | 1901.3 | 3.9469 | 0.001 509 | 1890.3 | 3.9089 | 420 |
| 430 | 0.001 656 | 1972.0 | 4.0711 | 0.001 594 | 1954.1 | 4.0225 | 0.001 546 | 1940.9 | 3.9814 | 430 |
| 440 | 0.001 712 | 2029.1 | 4.1517 | 0.001 641 | 2007.9 | 4.0984 | 0.001 586 | 1992.3 | 4.0540 | 440 |
| 450 | 0.001 774 | 2087.6 | 4.2331 | 0.001 691 | 2062.7 | 4.1747 | 0.001 628 | 2044.5 | 4.1267 | 450 |
| 460 | 0.001 842 | 2147.4 | 4.3153 | 0.001 746 | 2118.5 | 4.2514 | 0.001 674 | 2097.4 | 4.1994 | 460 |
| 470 | 0.001 918 | 2208.6 | 4.3982 | 0.001 805 | 2175.3 | 4.3284 | 0.001 723 | 2151.2 | 4.2722 | 470 |
| 480 | 0.002 001 | 2270.8 | 4.4814 | 0.001 870 | 2233.0 | 4.4055 | 0.001 776 | 2205.6 | 4.3450 | 480 |
| 490 | 0.002 091 | 2333.9 | 4.5646 | 0.001 939 | 2291.4 | 4.4825 | 0.001 833 | 2260.7 | 4.4176 | 490 |
| 500 | 0.002 188 | 2397.6 | 4.6474 | 0.002 014 | 2350.3 | 4.5593 | 0.001 893 | 2316.2 | 4.4899 | 500 |
| 510 | 0.002 292 | 2461.3 | 4.7294 | 0.002 094 | 2409.6 | 4.6355 | 0.001 957 | 2372.1 | 4.5618 | 510 |
| 520 | 0.002 403 | 2524.8 | 4.8099 | 0.002 179 | 2469.0 | 4.7108 | 0.002 025 | 2428.3 | 4.6330 | 520 |
| 530 | 0.002 518 | 2587.6 | 4.8886 | 0.002 268 | 2528.2 | 4.7850 | 0.002 097 | 2484.4 | 4.7033 | 530 |
| 540 | 0.002 638 | 2649.4 | 4.9651 | 0.002 361 | 2587.0 | 4.8578 | 0.002 172 | 2540.4 | 4.7726 | 540 |
| 550 | 0.002 760 | 2709.9 | 5.0391 | 0.002 458 | 2645.2 | 4.9288 | 0.002 250 | 2596.1 | 4.8407 | 550 |
| 560 | 0.002 885 | 2769.0 | 5.1103 | 0.002 557 | 2702.5 | 4.9981 | 0.002 330 | 2651.3 | 4.9074 | 560 |
| 570 | 0.003 010 | 2826.4 | 5.1789 | 0.002 658 | 2758.9 | 5.0653 | 0.002 413 | 2706.0 | 4.9726 | 570 |
| 580 | 0.003 135 | 2882.0 | 5.2445 | 0.002 761 | 2814.1 | 5.1304 | 0.002 498 | 2759.9 | 5.0361 | 580 |
| 590 | 0.003 260 | 2935.9 | 5.3072 | 0.002 865 | 2868.1 | 5.1933 | 0.002 585 | 2812.9 | 5.0980 | 590 |
| 600 | 0.003 384 | 2988.1 | 5.3674 | 0.002 970 | 2920.8 | 5.2540 | 0.002 672 | 2865.1 | 5.1580 | 600 |
| 610 | 0.003 506 | 3038.6 | 5.4249 | 0.003 074 | 2972.2 | 5.3125 | 0.002 761 | 2916.4 | 5.2165 | 610 |
| 620 | 0.003 626 | 3087.6 | 5.4800 | 0.003 177 | 3022.2 | 5.3689 | 0.002 850 | 2966.7 | 5.2731 | 620 |
| 630 | 0.003 744 | 3135.0 | 5.5328 | 0.003 280 | 3070.9 | 5.4231 | 0.002 938 | 3015.9 | 5.3279 | 630 |
| 640 | 0.003 861 | 3181.0 | 5.5835 | 0.003 382 | 3118.3 | 5.4753 | 0.003 026 | 3063.8 | 5.3806 | 640 |
| 650 | 0.003 975 | 3225.7 | 5.6321 | 0.003 482 | 3164.4 | 5.5255 | 0.003 114 | 3110.6 | 5.4316 | 650 |
| 660 | 0.004 087 | 3269.2 | 5.6790 | 0.003 582 | 3209.4 | 5.5741 | 0.003 202 | 3156.4 | 5.4809 | 660 |
| 670 | 0.004 197 | 3311.6 | 5.7242 | 0.003 680 | 3253.4 | 5.6209 | 0.003 289 | 3201.3 | 5.5288 | 670 |
| 680 | 0.004 306 | 3352.9 | 5.7678 | 0.003 777 | 3296.4 | 5.6663 | 0.003 376 | 3245.3 | 5.5752 | 680 |
| 690 | 0.004 412 | 3393.4 | 5.8100 | 0.003 872 | 3338.4 | 5.7101 | 0.003 461 | 3288.4 | 5.6202 | 690 |
| 700 | 0.004 516 | 3432.9 | 5.8509 | 0.003 966 | 3379.5 | 5.7526 | 0.003 546 | 3330.8 | 5.6640 | 700 |
| 710 | 0.004 619 | 3471.7 | 5.8905 | 0.004 059 | 3419.8 | 5.7938 | 0.003 630 | 3372.3 | 5.7064 | 710 |
| 720 | 0.004 720 | 3509.7 | 5.9290 | 0.004 150 | 3459.3 | 5.8337 | 0.003 712 | 3413.0 | 5.7476 | 720 |
| 730 | 0.004 819 | 3547.0 | 5.9663 | 0.004 240 | 3498.0 | 5.8725 | 0.003 794 | 3452.9 | 5.7876 | 730 |
| 740 | 0.004 917 | 3583.6 | 6.0027 | 0.004 329 | 3536.1 | 5.9103 | 0.003 874 | 3492.1 | 5.8265 | 740 |
| 750 | 0.005 013 | 3619.7 | 6.0382 | 0.004 416 | 3573.5 | 5.9470 | 0.003 953 | 3530.7 | 5.8644 | 750 |
| 760 | 0.005 108 | 3655.3 | 6.0728 | 0.004 502 | 3610.4 | 5.9829 | 0.004 031 | 3568.6 | 5.9013 | 760 |
| 770 | 0.005 202 | 3690.4 | 6.1066 | 0.004 587 | 3646.7 | 6.0179 | 0.004 109 | 3606.0 | 5.9373 | 770 |
| 780 | 0.005 295 | 3725.1 | 6.1397 | 0.004 671 | 3682.5 | 6.0521 | 0.004 185 | 3642.8 | 5.9724 | 780 |
| 790 | 0.005 386 | 3759.4 | 6.1721 | 0.004 754 | 3718.0 | 6.0856 | 0.004 261 | 3679.2 | 6.0068 | 790 |
| 800 | 0.005 476 | 3793.3 | 6.2039 | 0.004 836 | 3753.0 | 6.1184 | 0.004 336 | 3715.2 | 6.0405 | 800 |

**UNITS:** $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-4. Properties of Steam at High Temperatures

| t (°C) | 0.01 MPa | | | 0.05 MPa | | | 0.1 MPa | | | t (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | v | h | s | v | h | s | v | h | s | |
| **500** | 35.680 | 3489.7 | 9.8997 | 7.1339 | 3489.2 | 9.1565 | 3.5656 | 3488.7 | 8.8361 | **500** |
| **525** | 36.834 | 3543.2 | 9.9678 | 7.3649 | 3542.8 | 9.2246 | 3.6812 | 3542.3 | 8.9043 | **525** |
| **550** | 37.988 | 3597.1 | 10.034 | 7.5959 | 3596.7 | 9.2912 | 3.7968 | 3596.3 | 8.9709 | **550** |
| **575** | 39.142 | 3651.5 | 10.099 | 7.8268 | 3651.1 | 9.3563 | 3.9124 | 3650.7 | 9.0360 | **575** |
| **600** | 40.296 | 3706.3 | 10.163 | 8.0578 | 3706.0 | 9.4200 | 4.0279 | 3705.6 | 9.0998 | **600** |
| **625** | 41.450 | 3761.5 | 10.225 | 8.2887 | 3761.2 | 9.4824 | 4.1435 | 3760.9 | 9.1622 | **625** |
| **650** | 42.604 | 3817.2 | 10.287 | 8.5196 | 3816.9 | 9.5436 | 4.2590 | 3816.6 | 9.2234 | **650** |
| **675** | 43.758 | 3873.3 | 10.347 | 8.7505 | 3873.1 | 9.6036 | 4.3745 | 3872.8 | 9.2834 | **675** |
| **700** | 44.912 | 3929.9 | 10.405 | 8.9814 | 3929.7 | 9.6625 | 4.4900 | 3929.4 | 9.3424 | **700** |
| **725** | 46.066 | 3986.9 | 10.463 | 9.2123 | 3986.7 | 9.7204 | 4.6055 | 3986.4 | 9.4003 | **725** |
| **750** | 47.220 | 4044.4 | 10.520 | 9.4431 | 4044.2 | 9.7772 | 4.7210 | 4043.9 | 9.4571 | **750** |
| **775** | 48.374 | 4102.3 | 10.576 | 9.6740 | 4102.1 | 9.8332 | 4.8365 | 4101.8 | 9.5131 | **775** |
| **800** | 49.528 | 4160.6 | 10.631 | 9.9048 | 4160.5 | 9.8882 | 4.9520 | 4160.2 | 9.5681 | **800** |
| **825** | 50.682 | 4219.4 | 10.685 | 10.136 | 4219.3 | 9.9424 | 5.0674 | 4219.1 | 9.6223 | **825** |
| **850** | 51.836 | 4278.7 | 10.739 | 10.367 | 4278.5 | 9.9957 | 5.1829 | 4278.3 | 9.6757 | **850** |
| **875** | 52.989 | 4338.3 | 10.791 | 10.597 | 4338.2 | 10.048 | 5.2983 | 4338.0 | 9.7282 | **875** |
| **900** | 54.143 | 4398.4 | 10.843 | 10.828 | 4398.2 | 10.100 | 5.4138 | 4398.1 | 9.7800 | **900** |
| **925** | 55.297 | 4458.9 | 10.894 | 11.059 | 4458.7 | 10.151 | 5.5292 | 4458.6 | 9.8310 | **925** |
| **950** | 56.451 | 4519.8 | 10.944 | 11.290 | 4519.6 | 10.201 | 5.6447 | 4519.5 | 9.8813 | **950** |
| **975** | 57.605 | 4581.1 | 10.994 | 11.521 | 4581.0 | 10.251 | 5.7601 | 4580.8 | 9.9309 | **975** |
| **1000** | 58.759 | 4642.8 | 11.043 | 11.751 | 4642.7 | 10.300 | 5.8755 | 4642.5 | 9.9799 | **1000** |
| **1025** | 59.913 | 4704.9 | 11.091 | 11.982 | 4704.8 | 10.348 | 5.9910 | 4704.7 | 10.028 | **1025** |
| **1050** | 61.067 | 4767.4 | 11.139 | 12.213 | 4767.3 | 10.396 | 6.1064 | 4767.2 | 10.076 | **1050** |
| **1075** | 62.220 | 4830.4 | 11.186 | 12.444 | 4830.3 | 10.443 | 6.2218 | 4830.1 | 10.123 | **1075** |
| **1100** | 63.374 | 4893.7 | 11.232 | 12.675 | 4893.6 | 10.490 | 6.3372 | 4893.5 | 10.170 | **1100** |
| **1125** | 64.528 | 4957.4 | 11.278 | 12.905 | 4957.3 | 10.536 | 6.4527 | 4957.2 | 10.216 | **1125** |
| **1150** | 65.682 | 5021.4 | 11.324 | 13.136 | 5021.3 | 10.581 | 6.5681 | 5021.2 | 10.261 | **1150** |
| **1175** | 66.836 | 5085.9 | 11.369 | 13.367 | 5085.8 | 10.626 | 6.6835 | 5085.7 | 10.306 | **1175** |
| **1200** | 67.990 | 5150.7 | 11.413 | 13.598 | 5150.6 | 10.670 | 6.7989 | 5150.5 | 10.350 | **1200** |
| **1225** | 69.143 | 5215.8 | 11.457 | 13.829 | 5215.7 | 10.714 | 6.9143 | 5215.7 | 10.394 | **1225** |
| **1250** | 70.297 | 5281.3 | 11.500 | 14.059 | 5281.3 | 10.757 | 7.0297 | 5281.2 | 10.438 | **1250** |
| **1275** | 71.451 | 5347.2 | 11.543 | 14.290 | 5347.1 | 10.800 | 7.1451 | 5347.0 | 10.480 | **1275** |
| **1300** | 72.605 | 5413.4 | 11.586 | 14.521 | 5413.3 | 10.843 | 7.2605 | 5413.2 | 10.523 | **1300** |
| **1325** | 73.759 | 5479.9 | 11.628 | 14.752 | 5479.8 | 10.885 | 7.3760 | 5479.7 | 10.565 | **1325** |
| **1350** | 74.913 | 5546.7 | 11.669 | 14.983 | 5546.6 | 10.926 | 7.4914 | 5546.6 | 10.606 | **1350** |
| **1375** | 76.067 | 5613.8 | 11.710 | 15.213 | 5613.8 | 10.967 | 7.6068 | 5613.7 | 10.647 | **1375** |
| **1400** | 77.220 | 5681.3 | 11.751 | 15.444 | 5681.2 | 11.008 | 7.7222 | 5681.2 | 10.688 | **1400** |
| **1425** | 78.374 | 5749.0 | 11.791 | 15.675 | 5749.0 | 11.048 | 7.8376 | 5748.9 | 10.728 | **1425** |
| **1450** | 79.528 | 5817.1 | 11.831 | 15.906 | 5817.0 | 11.088 | 7.9530 | 5817.0 | 10.768 | **1450** |
| **1475** | 80.682 | 5885.4 | 11.870 | 16.137 | 5885.4 | 11.127 | 8.0684 | 5885.3 | 10.807 | **1475** |
| **1500** | 81.836 | 5954.0 | 11.909 | 16.367 | 5954.0 | 11.166 | 8.1838 | 5953.9 | 10.846 | **1500** |
| **1525** | 82.990 | 6022.9 | 11.948 | 16.598 | 6022.9 | 11.205 | 8.2992 | 6022.8 | 10.885 | **1525** |
| **1550** | 84.143 | 6092.1 | 11.986 | 16.829 | 6092.0 | 11.243 | 8.4146 | 6092.0 | 10.923 | **1550** |
| **1575** | 85.297 | 6161.5 | 12.024 | 17.060 | 6161.5 | 11.281 | 8.5300 | 6161.4 | 10.961 | **1575** |
| **1600** | 86.451 | 6231.2 | 12.061 | 17.290 | 6231.1 | 11.318 | 8.6454 | 6231.1 | 10.998 | **1600** |
| **1650** | 88.759 | 6371.3 | 12.135 | 17.752 | 6371.2 | 11.392 | 8.8762 | 6371.2 | 11.072 | **1650** |
| **1700** | 91.066 | 6512.3 | 12.207 | 18.214 | 6512.3 | 11.464 | 9.1069 | 6512.3 | 11.145 | **1700** |
| **1750** | 93.374 | 6654.3 | 12.278 | 18.675 | 6654.3 | 11.536 | 9.3377 | 6654.3 | 11.216 | **1750** |
| **1800** | 95.682 | 6797.2 | 12.348 | 19.137 | 6797.2 | 11.605 | 9.5685 | 6797.1 | 11.285 | **1800** |
| **1850** | 97.989 | 6940.9 | 12.417 | 19.598 | 6940.9 | 11.674 | 9.7993 | 6940.9 | 11.354 | **1850** |
| **1900** | 100.30 | 7085.5 | 12.484 | 20.060 | 7085.5 | 11.741 | 10.030 | 7085.4 | 11.421 | **1900** |
| **1950** | 102.60 | 7230.8 | 12.550 | 20.521 | 7230.8 | 11.807 | 10.261 | 7230.8 | 11.487 | **1950** |
| **2000** | 104.91 | 7377.0 | 12.615 | 20.983 | 7377.0 | 11.872 | 10.492 | 7377.0 | 11.552 | **2000** |

**UNITS:** $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-4. Properties of Steam at High Temperatures (cont'd)

| t (°C) | 0.2 MPa | | | 0.4 MPa | | | 0.6 MPa | | | t (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | v | h | s | v | h | s | v | h | s | |
| 500 | 1.7814 | 3487.6 | 8.5151 | 0.889 36 | 3485.5 | 8.1931 | 0.592 00 | 3483.3 | 8.0039 | 500 |
| 525 | 1.8394 | 3541.3 | 8.5834 | 0.918 45 | 3539.3 | 8.2617 | 0.611 48 | 3537.3 | 8.0727 | 525 |
| 550 | 1.8973 | 3595.4 | 8.6501 | 0.947 52 | 3593.6 | 8.3286 | 0.630 93 | 3591.7 | 8.1398 | 550 |
| 575 | 1.9552 | 3649.9 | 8.7154 | 0.976 56 | 3648.2 | 8.3940 | 0.650 36 | 3646.5 | 8.2053 | 575 |
| 600 | 2.0130 | 3704.8 | 8.7792 | 1.0056 | 3703.2 | 8.4579 | 0.669 77 | 3701.7 | 8.2694 | 600 |
| 625 | 2.0709 | 3760.1 | 8.8417 | 1.0346 | 3758.7 | 8.5205 | 0.689 16 | 3757.3 | 8.3322 | 625 |
| 650 | 2.1287 | 3815.9 | 8.9029 | 1.0636 | 3814.6 | 8.5819 | 0.708 54 | 3813.2 | 8.3937 | 650 |
| 675 | 2.1866 | 3872.1 | 8.9630 | 1.0926 | 3870.9 | 8.6421 | 0.727 90 | 3869.6 | 8.4539 | 675 |
| 700 | 2.2444 | 3928.8 | 9.0220 | 1.1215 | 3927.6 | 8.7012 | 0.747 25 | 3926.5 | 8.5131 | 700 |
| 725 | 2.3022 | 3985.9 | 9.0799 | 1.1505 | 3984.8 | 8.7592 | 0.766 59 | 3983.7 | 8.5712 | 725 |
| 750 | 2.3600 | 4043.4 | 9.1368 | 1.1794 | 4042.4 | 8.8161 | 0.785 93 | 4041.4 | 8.6282 | 750 |
| 775 | 2.4177 | 4101.4 | 9.1928 | 1.2084 | 4100.4 | 8.8722 | 0.805 25 | 4099.4 | 8.6843 | 775 |
| 800 | 2.4755 | 4159.8 | 9.2479 | 1.2373 | 4158.9 | 8.9273 | 0.824 58 | 4158.0 | 8.7395 | 800 |
| 825 | 2.5333 | 4218.6 | 9.3021 | 1.2662 | 4217.8 | 8.9815 | 0.843 89 | 4216.9 | 8.7938 | 825 |
| 850 | 2.5911 | 4277.9 | 9.3555 | 1.2952 | 4277.1 | 9.0350 | 0.863 20 | 4276.3 | 8.8472 | 850 |
| 875 | 2.6488 | 4337.6 | 9.4080 | 1.3241 | 4336.8 | 9.0876 | 0.882 50 | 4336.1 | 8.8999 | 875 |
| 900 | 2.7066 | 4397.7 | 9.4598 | 1.3530 | 4397.0 | 9.1394 | 0.901 79 | 4396.2 | 8.9517 | 900 |
| 925 | 2.7643 | 4458.2 | 9.5108 | 1.3819 | 4457.5 | 9.1905 | 0.921 09 | 4456.8 | 9.0028 | 925 |
| 950 | 2.8221 | 4519.1 | 9.5612 | 1.4108 | 4518.5 | 9.2408 | 0.940 38 | 4517.8 | 9.0532 | 950 |
| 975 | 2.8798 | 4580.5 | 9.6108 | 1.4397 | 4579.9 | 9.2905 | 0.959 66 | 4579.3 | 9.1029 | 975 |
| 1000 | 2.9376 | 4642.2 | 9.6598 | 1.4686 | 4641.7 | 9.3395 | 0.978 94 | 4641.1 | 9.1520 | 1000 |
| 1025 | 2.9953 | 4704.4 | 9.7082 | 1.4975 | 4703.8 | 9.3879 | 0.998 22 | 4703.3 | 9.2004 | 1025 |
| 1050 | 3.0531 | 4766.9 | 9.7559 | 1.5264 | 4766.4 | 9.4356 | 1.0175 | 4765.9 | 9.2481 | 1050 |
| 1075 | 3.1108 | 4829.9 | 9.8030 | 1.5553 | 4829.4 | 9.4828 | 1.0368 | 4828.9 | 9.2953 | 1075 |
| 1100 | 3.1685 | 4893.2 | 9.8496 | 1.5842 | 4892.8 | 9.5293 | 1.0560 | 4892.3 | 9.3419 | 1100 |
| 1125 | 3.2263 | 4956.9 | 9.8955 | 1.6130 | 4956.5 | 9.5753 | 1.0753 | 4956.0 | 9.3879 | 1125 |
| 1150 | 3.2840 | 5021.0 | 9.9410 | 1.6419 | 5020.6 | 9.6208 | 1.0946 | 5020.2 | 9.4334 | 1150 |
| 1175 | 3.3417 | 5085.5 | 9.9859 | 1.6708 | 5085.1 | 9.6657 | 1.1138 | 5084.7 | 9.4783 | 1175 |
| 1200 | 3.3994 | 5150.3 | 10.030 | 1.6997 | 5149.9 | 9.7101 | 1.1331 | 5149.5 | 9.5227 | 1200 |
| 1225 | 3.4571 | 5215.5 | 10.074 | 1.7286 | 5215.1 | 9.7540 | 1.1524 | 5214.7 | 9.5666 | 1225 |
| 1250 | 3.5149 | 5281.0 | 10.117 | 1.7574 | 5280.7 | 9.7974 | 1.1716 | 5280.3 | 9.6100 | 1250 |
| 1275 | 3.5726 | 5346.9 | 10.160 | 1.7863 | 5346.5 | 9.8403 | 1.1909 | 5346.2 | 9.6529 | 1275 |
| 1300 | 3.6303 | 5413.1 | 10.203 | 1.8152 | 5412.7 | 9.8827 | 1.2101 | 5412.4 | 9.6953 | 1300 |
| 1325 | 3.6880 | 5479.6 | 10.245 | 1.8440 | 5479.3 | 9.9246 | 1.2294 | 5479.0 | 9.7373 | 1325 |
| 1350 | 3.7457 | 5546.4 | 10.286 | 1.8729 | 5546.1 | 9.9662 | 1.2486 | 5545.9 | 9.7788 | 1350 |
| 1375 | 3.8034 | 5613.6 | 10.327 | 1.9018 | 5613.3 | 10.007 | 1.2679 | 5613.1 | 9.8199 | 1375 |
| 1400 | 3.8612 | 5681.0 | 10.368 | 1.9307 | 5680.8 | 10.048 | 1.2872 | 5680.5 | 9.8606 | 1400 |
| 1425 | 3.9189 | 5748.8 | 10.408 | 1.9595 | 5748.6 | 10.088 | 1.3064 | 5748.3 | 9.9008 | 1425 |
| 1450 | 3.9766 | 5816.9 | 10.448 | 1.9884 | 5816.6 | 10.128 | 1.3257 | 5816.4 | 9.9406 | 1450 |
| 1475 | 4.0343 | 5885.2 | 10.487 | 2.0172 | 5885.0 | 10.167 | 1.3449 | 5884.8 | 9.9800 | 1475 |
| 1500 | 4.0920 | 5953.8 | 10.526 | 2.0461 | 5953.6 | 10.206 | 1.3641 | 5953.4 | 10.019 | 1500 |
| 1525 | 4.1497 | 6022.7 | 10.565 | 2.0750 | 6022.5 | 10.245 | 1.3834 | 6022.4 | 10.058 | 1525 |
| 1550 | 4.2074 | 6091.9 | 10.603 | 2.1038 | 6091.7 | 10.283 | 1.4026 | 6091.5 | 10.096 | 1550 |
| 1575 | 4.2651 | 6161.3 | 10.641 | 2.1327 | 6161.2 | 10.321 | 1.4219 | 6161.0 | 10.134 | 1575 |
| 1600 | 4.3228 | 6231.0 | 10.678 | 2.1616 | 6230.9 | 10.358 | 1.4411 | 6230.7 | 10.171 | 1600 |
| 1650 | 4.4382 | 6371.1 | 10.752 | 2.2193 | 6371.0 | 10.432 | 1.4796 | 6370.8 | 10.245 | 1650 |
| 1700 | 4.5536 | 6512.2 | 10.825 | 2.2770 | 6512.1 | 10.505 | 1.5181 | 6512.0 | 10.317 | 1700 |
| 1750 | 4.6690 | 6654.2 | 10.896 | 2.3347 | 6654.1 | 10.576 | 1.5566 | 6654.0 | 10.388 | 1750 |
| 1800 | 4.7845 | 6797.1 | 10.965 | 2.3924 | 6797.0 | 10.645 | 1.5951 | 6796.9 | 10.458 | 1800 |
| 1850 | 4.8999 | 6940.8 | 11.034 | 2.4501 | 6940.7 | 10.714 | 1.6336 | 6940.7 | 10.527 | 1850 |
| 1900 | 5.0153 | 7085.4 | 11.101 | 2.5078 | 7085.3 | 10.781 | 1.6720 | 7085.3 | 10.594 | 1900 |
| 1950 | 5.1307 | 7230.8 | 11.167 | 2.5655 | 7230.7 | 10.847 | 1.7105 | 7230.6 | 10.660 | 1950 |
| 2000 | 5.2460 | 7376.9 | 11.232 | 2.6233 | 7376.9 | 10.912 | 1.7490 | 7376.8 | 10.725 | 2000 |

**UNITS:** $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-4. Properties of Steam at High Temperatures (cont'd)

| t (°C) | 1.0 MPa | | | 1.5 MPa | | | 2.0 MPa | | | t (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | v | h | s | v | h | s | v | h | s | |
| 500 | 0.354 11 | 3479.0 | 7.7640 | 0.235 16 | 3473.6 | 7.5716 | 0.175 68 | 3468.1 | 7.4335 | 500 |
| 525 | 0.365 90 | 3533.4 | 7.8332 | 0.243 10 | 3528.4 | 7.6413 | 0.181 70 | 3523.4 | 7.5038 | 525 |
| 550 | 0.377 66 | 3588.1 | 7.9007 | 0.251 02 | 3583.5 | 7.7093 | 0.187 69 | 3578.9 | 7.5723 | 550 |
| 575 | 0.389 39 | 3643.1 | 7.9665 | 0.258 91 | 3638.9 | 7.7756 | 0.193 66 | 3634.6 | 7.6391 | 575 |
| 600 | 0.401 11 | 3698.6 | 8.0309 | 0.266 78 | 3694.6 | 7.8404 | 0.199 61 | 3690.7 | 7.7042 | 600 |
| 625 | 0.412 81 | 3754.4 | 8.0940 | 0.274 64 | 3750.7 | 7.9037 | 0.205 55 | 3747.1 | 7.7679 | 625 |
| 650 | 0.424 50 | 3810.5 | 8.1557 | 0.282 48 | 3807.2 | 7.9657 | 0.211 46 | 3803.8 | 7.8301 | 650 |
| 675 | 0.436 17 | 3867.1 | 8.2161 | 0.290 30 | 3864.0 | 8.0264 | 0.217 37 | 3860.8 | 7.8911 | 675 |
| 700 | 0.447 83 | 3924.1 | 8.2755 | 0.298 12 | 3921.2 | 8.0860 | 0.223 26 | 3918.2 | 7.9509 | 700 |
| 725 | 0.459 48 | 3981.5 | 8.3337 | 0.305 92 | 3978.8 | 8.1444 | 0.229 14 | 3976.0 | 8.0095 | 725 |
| 750 | 0.471 12 | 4039.3 | 8.3909 | 0.313 72 | 4036.7 | 8.2018 | 0.235 01 | 4034.2 | 8.0670 | 750 |
| 775 | 0.482 75 | 4097.5 | 8.4471 | 0.321 50 | 4095.1 | 8.2581 | 0.240 88 | 4092.7 | 8.1235 | 775 |
| 800 | 0.494 39 | 4156.1 | 8.5023 | 0.329 29 | 4153.9 | 8.3135 | 0.246 74 | 4151.6 | 8.1790 | 800 |
| 825 | 0.506 01 | 4215.2 | 8.5568 | 0.337 06 | 4213.0 | 8.3680 | 0.252 59 | 4210.9 | 8.2337 | 825 |
| 850 | 0.517 62 | 4274.7 | 8.6103 | 0.344 83 | 4272.6 | 8.4217 | 0.258 44 | 4270.6 | 8.2874 | 850 |
| 875 | 0.529 23 | 4334.5 | 8.6630 | 0.352 60 | 4332.6 | 8.4745 | 0.264 28 | 4330.7 | 8.3403 | 875 |
| 900 | 0.540 83 | 4394.8 | 8.7149 | 0.360 36 | 4393.0 | 8.5265 | 0.270 12 | 4391.2 | 8.3925 | 900 |
| 925 | 0.552 44 | 4455.5 | 8.7661 | 0.368 11 | 4453.8 | 8.5778 | 0.275 95 | 4452.0 | 8.4438 | 925 |
| 950 | 0.564 03 | 4516.6 | 8.8166 | 0.375 86 | 4514.9 | 8.6283 | 0.281 77 | 4513.3 | 8.4944 | 950 |
| 975 | 0.575 62 | 4578.0 | 8.8663 | 0.383 61 | 4576.5 | 8.6781 | 0.287 60 | 4575.0 | 8.5443 | 975 |
| 1000 | 0.587 21 | 4639.9 | 8.9154 | 0.391 35 | 4638.5 | 8.7273 | 0.293 42 | 4637.0 | 8.5935 | 1000 |
| 1025 | 0.598 80 | 4702.2 | 8.9639 | 0.399 09 | 4700.8 | 8.7758 | 0.299 24 | 4699.4 | 8.6421 | 1025 |
| 1050 | 0.610 38 | 4764.9 | 9.0117 | 0.406 83 | 4763.5 | 8.8237 | 0.305 05 | 4762.2 | 8.6900 | 1050 |
| 1075 | 0.621 97 | 4827.9 | 9.0589 | 0.414 56 | 4826.7 | 8.8709 | 0.310 86 | 4825.4 | 8.7373 | 1075 |
| 1100 | 0.633 54 | 4891.3 | 9.1055 | 0.422 30 | 4890.2 | 8.9176 | 0.316 67 | 4889.0 | 8.7840 | 1100 |
| 1125 | 0.645 12 | 4955.1 | 9.1515 | 0.430 03 | 4954.0 | 8.9637 | 0.322 48 | 4952.9 | 8.8302 | 1125 |
| 1150 | 0.656 69 | 5019.3 | 9.1970 | 0.437 75 | 5018.3 | 9.0092 | 0.328 29 | 5017.2 | 8.8757 | 1150 |
| 1175 | 0.668 27 | 5083.9 | 9.2420 | 0.445 48 | 5082.9 | 9.0542 | 0.334 09 | 5081.9 | 8.9208 | 1175 |
| 1200 | 0.679 84 | 5148.8 | 9.2864 | 0.453 21 | 5147.8 | 9.0987 | 0.339 89 | 5146.9 | 8.9653 | 1200 |
| 1225 | 0.691 41 | 5214.0 | 9.3304 | 0.460 93 | 5213.1 | 9.1426 | 0.345 69 | 5212.2 | 9.0093 | 1225 |
| 1250 | 0.702 97 | 5279.6 | 9.3738 | 0.468 65 | 5278.8 | 9.1861 | 0.351 49 | 5277.9 | 9.0527 | 1250 |
| 1275 | 0.714 54 | 5345.5 | 9.4167 | 0.476 37 | 5344.7 | 9.2290 | 0.357 28 | 5343.9 | 9.0957 | 1275 |
| 1300 | 0.726 10 | 5411.8 | 9.4592 | 0.484 09 | 5411.0 | 9.2715 | 0.363 08 | 5410.3 | 9.1382 | 1300 |
| 1325 | 0.737 67 | 5478.4 | 9.5012 | 0.491 80 | 5477.7 | 9.3136 | 0.368 87 | 5476.9 | 9.1803 | 1325 |
| 1350 | 0.749 23 | 5545.3 | 9.5427 | 0.499 52 | 5544.6 | 9.3551 | 0.374 67 | 5543.9 | 9.2219 | 1350 |
| 1375 | 0.760 79 | 5612.5 | 9.5838 | 0.507 24 | 5611.9 | 9.3962 | 0.380 46 | 5611.2 | 9.2630 | 1375 |
| 1400 | 0.772 35 | 5680.0 | 9.6245 | 0.514 95 | 5679.4 | 9.4369 | 0.386 25 | 5678.8 | 9.3037 | 1400 |
| 1425 | 0.783 91 | 5747.9 | 9.6647 | 0.522 66 | 5747.3 | 9.4772 | 0.392 04 | 5746.7 | 9.3440 | 1425 |
| 1450 | 0.795 47 | 5816.0 | 9.7045 | 0.530 37 | 5815.4 | 9.5170 | 0.397 83 | 5814.8 | 9.3838 | 1450 |
| 1475 | 0.807 02 | 5884.4 | 9.7439 | 0.538 08 | 5883.8 | 9.5564 | 0.403 61 | 5883.3 | 9.4233 | 1475 |
| 1500 | 0.818 58 | 5953.0 | 9.7829 | 0.545 79 | 5952.5 | 9.5954 | 0.409 40 | 5952.0 | 9.4623 | 1500 |
| 1525 | 0.830 13 | 6022.0 | 9.8215 | 0.553 50 | 6021.5 | 9.6341 | 0.415 19 | 6021.0 | 9.5010 | 1525 |
| 1550 | 0.841 69 | 6091.2 | 9.8597 | 0.561 21 | 6090.7 | 9.6723 | 0.420 97 | 6090.3 | 9.5392 | 1550 |
| 1575 | 0.853 24 | 6160.6 | 9.8976 | 0.568 92 | 6160.2 | 9.7102 | 0.426 76 | 6159.8 | 9.5771 | 1575 |
| 1600 | 0.864 80 | 6230.4 | 9.9351 | 0.576 63 | 6230.0 | 9.7476 | 0.432 54 | 6229.6 | 9.6146 | 1600 |
| 1650 | 0.887 90 | 6370.6 | 10.009 | 0.592 04 | 6370.2 | 9.8215 | 0.444 11 | 6369.8 | 9.6885 | 1650 |
| 1700 | 0.911 00 | 6511.7 | 10.081 | 0.607 45 | 6511.4 | 9.8940 | 0.455 67 | 6511.1 | 9.7610 | 1700 |
| 1750 | 0.934 10 | 6653.8 | 10.152 | 0.622 86 | 6653.5 | 9.9651 | 0.467 23 | 6653.2 | 9.8321 | 1750 |
| 1800 | 0.957 20 | 6796.7 | 10.222 | 0.638 26 | 6796.5 | 10.035 | 0.478 79 | 6796.2 | 9.9019 | 1800 |
| 1850 | 0.980 30 | 6940.5 | 10.291 | 0.653 67 | 6940.3 | 10.103 | 0.490 35 | 6940.1 | 9.9705 | 1850 |
| 1900 | 1.0034 | 7085.1 | 10.358 | 0.669 07 | 7084.9 | 10.171 | 0.501 91 | 7084.7 | 10.038 | 1900 |
| 1950 | 1.0265 | 7230.5 | 10.424 | 0.684 47 | 7230.4 | 10.237 | 0.513 47 | 7230.2 | 10.104 | 1950 |
| 2000 | 1.0496 | 7376.7 | 10.489 | 0.699 87 | 7376.6 | 10.302 | 0.525 02 | 7376.5 | 10.169 | 2000 |

**UNITS:** $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-4. Properties of Steam at High Temperatures (cont'd)

| | 3 MPa | | | 4 MPa | | | 5 MPa | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *t* (°C) | *v* | *h* | *s* | *v* | *h* | *s* | *v* | *h* | *s* | *t* (°C) |
| **500** | 0.116 19 | 3457.0 | 7.2356 | 0.086 44 | 3445.8 | 7.0919 | 0.068 58 | 3434.5 | 6.9778 | **500** |
| **525** | 0.120 29 | 3513.3 | 7.3072 | 0.089 58 | 3503.0 | 7.1647 | 0.071 15 | 3492.7 | 7.0519 | **525** |
| **550** | 0.124 37 | 3569.6 | 7.3767 | 0.092 70 | 3560.2 | 7.2353 | 0.073 69 | 3550.8 | 7.1235 | **550** |
| **575** | 0.128 42 | 3626.1 | 7.4443 | 0.095 79 | 3617.5 | 7.3038 | 0.076 21 | 3608.8 | 7.1930 | **575** |
| **600** | 0.132 44 | 3682.8 | 7.5102 | 0.098 86 | 3674.8 | 7.3704 | 0.078 70 | 3666.8 | 7.2604 | **600** |
| **625** | 0.136 46 | 3739.8 | 7.5745 | 0.101 91 | 3732.4 | 7.4354 | 0.081 18 | 3725.0 | 7.3261 | **625** |
| **650** | 0.140 45 | 3797.0 | 7.6373 | 0.104 94 | 3790.2 | 7.4989 | 0.083 64 | 3783.3 | 7.3901 | **650** |
| **675** | 0.144 43 | 3854.5 | 7.6988 | 0.107 96 | 3848.2 | 7.5608 | 0.086 08 | 3841.8 | 7.4526 | **675** |
| **700** | 0.148 40 | 3912.3 | 7.7590 | 0.110 97 | 3906.4 | 7.6215 | 0.088 51 | 3900.5 | 7.5137 | **700** |
| **725** | 0.152 36 | 3970.5 | 7.8180 | 0.113 97 | 3965.0 | 7.6809 | 0.090 94 | 3959.4 | 7.5735 | **725** |
| **750** | 0.156 31 | 4029.0 | 7.8759 | 0.116 96 | 4023.8 | 7.7391 | 0.093 35 | 4018.6 | 7.6321 | **750** |
| **775** | 0.160 25 | 4087.8 | 7.9327 | 0.119 94 | 4083.0 | 7.7962 | 0.095 75 | 4078.1 | 7.6896 | **775** |
| **800** | 0.164 19 | 4147.0 | 7.9885 | 0.122 92 | 4142.4 | 7.8523 | 0.098 16 | 4137.8 | 7.7458 | **800** |
| **825** | 0.168 12 | 4206.6 | 8.0434 | 0.125 89 | 4202.3 | 7.9074 | 0.100 55 | 4197.9 | 7.8012 | **825** |
| **850** | 0.172 05 | 4266.5 | 8.0973 | 0.128 85 | 4262.4 | 7.9616 | 0.102 93 | 4258.4 | 7.8556 | **850** |
| **875** | 0.175 96 | 4326.8 | 8.1504 | 0.131 81 | 4323.0 | 8.0149 | 0.105 31 | 4319.1 | 7.9091 | **875** |
| **900** | 0.179 88 | 4387.5 | 8.2027 | 0.134 76 | 4383.9 | 8.0674 | 0.107 69 | 4380.3 | 7.9618 | **900** |
| **925** | 0.183 78 | 4448.6 | 8.2543 | 0.137 70 | 4445.2 | 8.1191 | 0.110 06 | 4441.7 | 8.0136 | **925** |
| **950** | 0.187 69 | 4510.0 | 8.3050 | 0.140 65 | 4506.8 | 8.1700 | 0.112 42 | 4503.5 | 8.0647 | **950** |
| **975** | 0.191 59 | 4571.9 | 8.3550 | 0.143 59 | 4568.8 | 8.2201 | 0.114 78 | 4565.7 | 8.1150 | **975** |
| **1000** | 0.195 49 | 4634.1 | 8.4044 | 0.146 52 | 4631.2 | 8.2696 | 0.117 14 | 4628.2 | 8.1646 | **1000** |
| **1025** | 0.199 38 | 4696.7 | 8.4531 | 0.149 46 | 4693.9 | 8.3184 | 0.119 50 | 4691.1 | 8.2136 | **1025** |
| **1050** | 0.203 27 | 4759.6 | 8.5011 | 0.152 39 | 4757.0 | 8.3666 | 0.121 85 | 4754.4 | 8.2618 | **1050** |
| **1075** | 0.207 16 | 4822.9 | 8.5485 | 0.155 31 | 4820.5 | 8.4141 | 0.124 20 | 4818.0 | 8.3094 | **1075** |
| **1100** | 0.211 05 | 4886.6 | 8.5953 | 0.158 24 | 4884.3 | 8.4610 | 0.126 55 | 4881.9 | 8.3564 | **1100** |
| **1125** | 0.214 93 | 4950.7 | 8.6415 | 0.161 16 | 4948.4 | 8.5073 | 0.128 90 | 4946.2 | 8.4028 | **1125** |
| **1150** | 0.218 82 | 5015.1 | 8.6872 | 0.164 08 | 5013.0 | 8.5530 | 0.131 24 | 5010.8 | 8.4486 | **1150** |
| **1175** | 0.222 70 | 5079.8 | 8.7323 | 0.167 00 | 5077.8 | 8.5982 | 0.133 58 | 5075.8 | 8.4939 | **1175** |
| **1200** | 0.226 57 | 5144.9 | 8.7769 | 0.169 92 | 5143.0 | 8.6429 | 0.135 92 | 5141.1 | 8.5386 | **1200** |
| **1225** | 0.230 45 | 5210.4 | 8.8209 | 0.172 83 | 5208.6 | 8.6870 | 0.138 26 | 5206.8 | 8.5828 | **1225** |
| **1250** | 0.234 33 | 5276.2 | 8.8645 | 0.175 75 | 5274.4 | 8.7306 | 0.140 60 | 5272.7 | 8.6265 | **1250** |
| **1275** | 0.238 20 | 5342.3 | 8.9075 | 0.178 66 | 5340.6 | 8.7737 | 0.142 93 | 5339.0 | 8.6696 | **1275** |
| **1300** | 0.242 07 | 5408.7 | 8.9501 | 0.181 57 | 5407.2 | 8.8163 | 0.145 27 | 5405.6 | 8.7123 | **1300** |
| **1325** | 0.245 94 | 5475.4 | 8.9922 | 0.184 48 | 5474.0 | 8.8584 | 0.147 60 | 5472.5 | 8.7545 | **1325** |
| **1350** | 0.249 81 | 5542.5 | 9.0338 | 0.187 39 | 5541.1 | 8.9001 | 0.149 93 | 5539.7 | 8.7962 | **1350** |
| **1375** | 0.253 68 | 5609.9 | 9.0750 | 0.190 29 | 5608.5 | 8.9413 | 0.152 26 | 5607.2 | 8.8375 | **1375** |
| **1400** | 0.257 55 | 5677.5 | 9.1157 | 0.193 20 | 5676.3 | 8.9821 | 0.154 59 | 5675.0 | 8.8783 | **1400** |
| **1425** | 0.261 42 | 5745.5 | 9.1561 | 0.196 10 | 5744.3 | 9.0225 | 0.156 92 | 5743.1 | 8.9187 | **1425** |
| **1450** | 0.265 28 | 5813.7 | 9.1959 | 0.199 01 | 5812.6 | 9.0624 | 0.159 25 | 5811.4 | 8.9587 | **1450** |
| **1475** | 0.269 15 | 5882.2 | 9.2354 | 0.201 91 | 5881.1 | 9.1019 | 0.161 57 | 5880.1 | 8.9982 | **1475** |
| **1500** | 0.273 01 | 5951.0 | 9.2745 | 0.204 81 | 5950.0 | 9.1410 | 0.163 90 | 5949.0 | 9.0373 | **1500** |
| **1525** | 0.276 87 | 6020.0 | 9.3132 | 0.207 72 | 6019.1 | 9.1797 | 0.166 22 | 6018.1 | 9.0761 | **1525** |
| **1550** | 0.280 74 | 6089.4 | 9.3514 | 0.210 62 | 6088.5 | 9.2180 | 0.168 55 | 6087.5 | 9.1144 | **1550** |
| **1575** | 0.284 60 | 6158.9 | 9.3893 | 0.213 52 | 6158.1 | 9.2559 | 0.170 87 | 6157.2 | 9.1524 | **1575** |
| **1600** | 0.288 46 | 6228.7 | 9.4269 | 0.216 42 | 6227.9 | 9.2935 | 0.173 19 | 6227.1 | 9.1899 | **1600** |
| **1650** | 0.296 18 | 6369.1 | 9.5008 | 0.222 21 | 6368.4 | 9.3675 | 0.177 83 | 6367.7 | 9.2640 | **1650** |
| **1700** | 0.303 90 | 6510.4 | 9.5733 | 0.228 01 | 6509.8 | 9.4401 | 0.182 48 | 6509.2 | 9.3366 | **1700** |
| **1750** | 0.311 61 | 6652.6 | 9.6445 | 0.233 80 | 6652.1 | 9.5113 | 0.187 11 | 6651.5 | 9.4078 | **1750** |
| **1800** | 0.319 33 | 6795.7 | 9.7144 | 0.239 59 | 6795.2 | 9.5812 | 0.191 75 | 6794.7 | 9.4778 | **1800** |
| **1850** | 0.327 04 | 6939.6 | 9.7830 | 0.245 38 | 6939.2 | 9.6498 | 0.196 39 | 6938.8 | 9.5464 | **1850** |
| **1900** | 0.334 75 | 7084.4 | 9.8504 | 0.251 17 | 7084.0 | 9.7172 | 0.201 02 | 7083.7 | 9.6139 | **1900** |
| **1950** | 0.342 46 | 7229.9 | 9.9166 | 0.256 96 | 7229.6 | 9.7835 | 0.205 65 | 7229.3 | 9.6801 | **1950** |
| **2000** | 0.350 17 | 7376.2 | 9.9817 | 0.262 74 | 7376.0 | 9.8486 | 0.210 29 | 7375.7 | 9.7453 | **2000** |

**UNITS:** *v* in $m^3$/kg ; *h* in kJ/kg ; *s* in kJ/(kg·K)

## Table T-4. Properties of Steam at High Temperatures (cont'd)

| t (°C) | 6 MPa | | | 7 MPa | | | 8 MPa | | | t (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | v | h | s | v | h | s | v | h | s | |
| 500 | 0.056 67 | 3422.9 | 6.8824 | 0.048 16 | 3411.3 | 6.7997 | 0.041 77 | 3399.4 | 6.7264 | 500 |
| 525 | 0.058 86 | 3482.2 | 6.9578 | 0.050 08 | 3471.6 | 6.8766 | 0.043 49 | 3460.9 | 6.8047 | 525 |
| 550 | 0.061 02 | 3541.2 | 7.0306 | 0.051 97 | 3531.5 | 6.9505 | 0.045 17 | 3521.8 | 6.8798 | 550 |
| 575 | 0.063 15 | 3600.0 | 7.1009 | 0.053 83 | 3591.2 | 7.0218 | 0.046 83 | 3582.2 | 6.9522 | 575 |
| 600 | 0.065 26 | 3658.8 | 7.1692 | 0.055 66 | 3650.6 | 7.0909 | 0.048 46 | 3642.4 | 7.0221 | 600 |
| 625 | 0.067 36 | 3717.5 | 7.2356 | 0.057 48 | 3710.0 | 7.1580 | 0.050 08 | 3702.5 | 7.0899 | 625 |
| 650 | 0.069 43 | 3776.4 | 7.3002 | 0.059 28 | 3769.4 | 7.2232 | 0.051 67 | 3762.4 | 7.1557 | 650 |
| 675 | 0.071 49 | 3835.3 | 7.3632 | 0.061 07 | 3828.9 | 7.2868 | 0.053 26 | 3822.4 | 7.2198 | 675 |
| 700 | 0.073 54 | 3894.5 | 7.4248 | 0.062 85 | 3888.5 | 7.3488 | 0.054 83 | 3882.4 | 7.2823 | 700 |
| 725 | 0.075 58 | 3953.8 | 7.4850 | 0.064 61 | 3948.2 | 7.4094 | 0.056 38 | 3942.6 | 7.3434 | 725 |
| 750 | 0.077 61 | 4013.4 | 7.5439 | 0.066 37 | 4008.1 | 7.4687 | 0.057 93 | 4002.9 | 7.4030 | 750 |
| 775 | 0.079 63 | 4073.2 | 7.6017 | 0.068 11 | 4068.3 | 7.5268 | 0.059 47 | 4063.3 | 7.4614 | 775 |
| 800 | 0.081 65 | 4133.2 | 7.6582 | 0.069 85 | 4128.6 | 7.5836 | 0.061 01 | 4123.9 | 7.5185 | 800 |
| 825 | 0.083 65 | 4193.6 | 7.7139 | 0.071 59 | 4189.2 | 7.6395 | 0.062 54 | 4184.9 | 7.5746 | 825 |
| 850 | 0.085 65 | 4254.3 | 7.7685 | 0.073 31 | 4250.2 | 7.6944 | 0.064 06 | 4246.1 | 7.6297 | 850 |
| 875 | 0.087 65 | 4315.3 | 7.8222 | 0.075 03 | 4311.4 | 7.7483 | 0.065 57 | 4307.5 | 7.6839 | 875 |
| 900 | 0.089 64 | 4376.6 | 7.8751 | 0.076 75 | 4373.0 | 7.8013 | 0.067 08 | 4369.3 | 7.7371 | 900 |
| 925 | 0.091 62 | 4438.3 | 7.9271 | 0.078 46 | 4434.8 | 7.8535 | 0.068 59 | 4431.4 | 7.7894 | 925 |
| 950 | 0.093 61 | 4500.3 | 7.9783 | 0.080 17 | 4497.0 | 7.9049 | 0.070 09 | 4493.8 | 7.8410 | 950 |
| 975 | 0.095 58 | 4562.6 | 8.0288 | 0.081 87 | 4559.6 | 7.9555 | 0.071 58 | 4556.5 | 7.8917 | 975 |
| 1000 | 0.097 56 | 4625.3 | 8.0785 | 0.083 57 | 4622.4 | 8.0053 | 0.073 08 | 4619.5 | 7.9417 | 1000 |
| 1025 | 0.099 53 | 4688.4 | 8.1275 | 0.085 27 | 4685.6 | 8.0545 | 0.074 57 | 4682.8 | 7.9910 | 1025 |
| 1050 | 0.101 50 | 4751.8 | 8.1759 | 0.086 96 | 4749.1 | 8.1030 | 0.076 06 | 4746.5 | 8.0396 | 1050 |
| 1075 | 0.103 46 | 4815.5 | 8.2236 | 0.088 65 | 4813.0 | 8.1508 | 0.077 54 | 4810.5 | 8.0875 | 1075 |
| 1100 | 0.105 43 | 4879.6 | 8.2707 | 0.090 34 | 4877.2 | 8.1980 | 0.079 02 | 4874.9 | 8.1348 | 1100 |
| 1125 | 0.107 39 | 4944.0 | 8.3172 | 0.092 03 | 4941.7 | 8.2446 | 0.080 50 | 4939.5 | 8.1814 | 1125 |
| 1150 | 0.109 35 | 5008.7 | 8.3631 | 0.093 71 | 5006.6 | 8.2905 | 0.081 98 | 5004.5 | 8.2275 | 1150 |
| 1175 | 0.111 31 | 5073.8 | 8.4084 | 0.095 39 | 5071.8 | 8.3359 | 0.083 46 | 5069.8 | 8.2730 | 1175 |
| 1200 | 0.113 26 | 5139.2 | 8.4532 | 0.097 07 | 5137.3 | 8.3808 | 0.084 93 | 5135.4 | 8.3179 | 1200 |
| 1225 | 0.115 21 | 5205.0 | 8.4975 | 0.098 75 | 5203.1 | 8.4251 | 0.086 41 | 5201.3 | 8.3623 | 1225 |
| 1250 | 0.117 17 | 5271.0 | 8.5412 | 0.100 43 | 5269.3 | 8.4689 | 0.087 88 | 5267.6 | 8.4061 | 1250 |
| 1275 | 0.119 12 | 5337.4 | 8.5844 | 0.102 11 | 5335.7 | 8.5122 | 0.089 35 | 5334.1 | 8.4495 | 1275 |
| 1300 | 0.121 07 | 5404.1 | 8.6271 | 0.103 78 | 5402.5 | 8.5550 | 0.090 82 | 5401.0 | 8.4923 | 1300 |
| 1325 | 0.123 01 | 5471.0 | 8.6694 | 0.105 45 | 5469.6 | 8.5973 | 0.092 28 | 5468.1 | 8.5347 | 1325 |
| 1350 | 0.124 96 | 5538.3 | 8.7111 | 0.107 13 | 5536.9 | 8.6391 | 0.093 75 | 5535.5 | 8.5765 | 1350 |
| 1375 | 0.126 91 | 5605.9 | 8.7525 | 0.108 80 | 5604.6 | 8.6804 | 0.095 21 | 5603.3 | 8.6179 | 1375 |
| 1400 | 0.128 85 | 5673.8 | 8.7933 | 0.110 47 | 5672.5 | 8.7213 | 0.096 68 | 5671.3 | 8.6589 | 1400 |
| 1425 | 0.130 79 | 5741.9 | 8.8337 | 0.112 13 | 5740.7 | 8.7618 | 0.098 14 | 5739.5 | 8.6994 | 1425 |
| 1450 | 0.132 74 | 5810.3 | 8.8737 | 0.113 80 | 5809.2 | 8.8018 | 0.099 60 | 5808.1 | 8.7394 | 1450 |
| 1475 | 0.134 68 | 5879.0 | 8.9133 | 0.115 47 | 5877.9 | 8.8414 | 0.101 06 | 5876.9 | 8.7791 | 1475 |
| 1500 | 0.136 62 | 5948.0 | 8.9525 | 0.117 14 | 5947.0 | 8.8806 | 0.102 52 | 5945.9 | 8.8183 | 1500 |
| 1525 | 0.138 56 | 6017.2 | 8.9912 | 0.118 80 | 6016.2 | 8.9194 | 0.103 98 | 6015.3 | 8.8571 | 1525 |
| 1550 | 0.140 50 | 6086.6 | 9.0296 | 0.120 47 | 6085.7 | 8.9578 | 0.105 44 | 6084.8 | 8.8956 | 1550 |
| 1575 | 0.142 44 | 6156.4 | 9.0676 | 0.122 13 | 6155.5 | 8.9958 | 0.106 90 | 6154.7 | 8.9336 | 1575 |
| 1600 | 0.144 38 | 6226.3 | 9.1052 | 0.123 79 | 6225.5 | 9.0335 | 0.108 36 | 6224.7 | 8.9713 | 1600 |
| 1650 | 0.148 25 | 6367.0 | 9.1793 | 0.127 12 | 6366.3 | 9.1076 | 0.111 27 | 6365.5 | 9.0454 | 1650 |
| 1700 | 0.152 12 | 6508.5 | 9.2520 | 0.130 44 | 6507.9 | 9.1803 | 0.114 18 | 6507.3 | 9.1182 | 1700 |
| 1750 | 0.155 99 | 6651.0 | 9.3232 | 0.133 76 | 6650.4 | 9.2516 | 0.117 09 | 6649.9 | 9.1896 | 1750 |
| 1800 | 0.159 86 | 6794.3 | 9.3932 | 0.137 08 | 6793.8 | 9.3216 | 0.119 99 | 6793.3 | 9.2596 | 1800 |
| 1850 | 0.163 73 | 6938.4 | 9.4619 | 0.140 39 | 6938.0 | 9.3904 | 0.122 90 | 6937.6 | 9.3284 | 1850 |
| 1900 | 0.167 59 | 7083.3 | 9.5294 | 0.143 71 | 7082.9 | 9.4579 | 0.125 80 | 7082.6 | 9.3959 | 1900 |
| 1950 | 0.171 45 | 7229.0 | 9.5957 | 0.147 02 | 7228.7 | 9.5242 | 0.128 70 | 7228.4 | 9.4622 | 1950 |
| 2000 | 0.175 32 | 7375.5 | 9.6608 | 0.150 34 | 7375.2 | 9.5894 | 0.131 60 | 7375.0 | 9.5274 | 2000 |

UNITS: $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-4. Properties of Steam at High Temperatures (cont'd)

| | 10 MPa | | | 15 MPa | | | 20 MPa | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *t* (°C) | *v* | *h* | *s* | *v* | *h* | *s* | *v* | *h* | *s* | *t* (°C) |
| **500** | 0.032 81 | 3375.1 | 6.5993 | 0.020 83 | 3310.8 | 6.3479 | 0.014 793 | 3241.2 | 6.1445 | **500** |
| **525** | 0.034 25 | 3439.0 | 6.6807 | 0.021 91 | 3381.8 | 6.4383 | 0.015 708 | 3320.7 | 6.2458 | **525** |
| **550** | 0.035 66 | 3501.9 | 6.7584 | 0.022 95 | 3450.5 | 6.5230 | 0.016 571 | 3396.2 | 6.3390 | **550** |
| **575** | 0.037 03 | 3564.1 | 6.8328 | 0.023 95 | 3517.5 | 6.6033 | 0.017 393 | 3468.8 | 6.4258 | **575** |
| **600** | 0.038 38 | 3625.8 | 6.9045 | 0.024 92 | 3583.3 | 6.6797 | 0.018 184 | 3539.2 | 6.5077 | **600** |
| **625** | 0.039 71 | 3687.2 | 6.9738 | 0.025 87 | 3648.2 | 6.7530 | 0.018 950 | 3608.0 | 6.5854 | **625** |
| **650** | 0.041 02 | 3748.3 | 7.0409 | 0.026 80 | 3712.4 | 6.8235 | 0.019 694 | 3675.6 | 6.6596 | **650** |
| **675** | 0.042 31 | 3809.3 | 7.1061 | 0.027 72 | 3776.1 | 6.8916 | 0.020 42 | 3742.2 | 6.7308 | **675** |
| **700** | 0.043 59 | 3870.3 | 7.1696 | 0.028 62 | 3839.5 | 6.9576 | 0.021 13 | 3808.2 | 6.7994 | **700** |
| **725** | 0.044 87 | 3931.2 | 7.2314 | 0.029 51 | 3902.6 | 7.0216 | 0.021 83 | 3873.5 | 6.8658 | **725** |
| **750** | 0.046 13 | 3992.3 | 7.2918 | 0.030 39 | 3965.6 | 7.0839 | 0.022 52 | 3938.5 | 6.9301 | **750** |
| **775** | 0.047 38 | 4053.4 | 7.3509 | 0.031 26 | 4028.5 | 7.1447 | 0.023 20 | 4003.2 | 6.9925 | **775** |
| **800** | 0.048 63 | 4114.6 | 7.4085 | 0.032 12 | 4091.2 | 7.2038 | 0.023 87 | 4067.7 | 7.0532 | **800** |
| **825** | 0.049 87 | 4176.1 | 7.4652 | 0.032 98 | 4154.2 | 7.2618 | 0.024 53 | 4132.1 | 7.1126 | **825** |
| **850** | 0.051 10 | 4237.8 | 7.5207 | 0.033 82 | 4217.2 | 7.3185 | 0.025 19 | 4196.5 | 7.1705 | **850** |
| **875** | 0.052 32 | 4299.8 | 7.5753 | 0.034 67 | 4280.4 | 7.3741 | 0.025 84 | 4260.9 | 7.2273 | **875** |
| **900** | 0.053 55 | 4362.0 | 7.6289 | 0.035 50 | 4343.7 | 7.4287 | 0.026 48 | 4325.4 | 7.2828 | **900** |
| **925** | 0.054 76 | 4424.5 | 7.6816 | 0.036 33 | 4407.2 | 7.4823 | 0.027 12 | 4389.9 | 7.3373 | **925** |
| **950** | 0.055 98 | 4487.2 | 7.7334 | 0.037 16 | 4470.9 | 7.5349 | 0.027 76 | 4454.6 | 7.3907 | **950** |
| **975** | 0.057 18 | 4550.3 | 7.7845 | 0.037 99 | 4534.9 | 7.5867 | 0.028 39 | 4519.5 | 7.4432 | **975** |
| **1000** | 0.058 39 | 4613.7 | 7.8347 | 0.038 81 | 4599.1 | 7.6376 | 0.029 02 | 4584.5 | 7.4948 | **1000** |
| **1025** | 0.059 59 | 4677.3 | 7.8843 | 0.039 63 | 4663.5 | 7.6877 | 0.029 65 | 4649.8 | 7.5456 | **1025** |
| **1050** | 0.060 79 | 4741.3 | 7.9331 | 0.040 44 | 4728.2 | 7.7371 | 0.030 27 | 4715.2 | 7.5955 | **1050** |
| **1075** | 0.061 99 | 4805.6 | 7.9812 | 0.041 25 | 4793.2 | 7.7857 | 0.030 89 | 4780.9 | 7.6447 | **1075** |
| **1100** | 0.063 18 | 4870.2 | 8.0287 | 0.042 06 | 4858.4 | 7.8337 | 0.031 51 | 4846.8 | 7.6931 | **1100** |
| **1125** | 0.064 37 | 4935.1 | 8.0755 | 0.042 87 | 4924.0 | 7.8810 | 0.032 12 | 4912.9 | 7.7408 | **1125** |
| **1150** | 0.065 56 | 5000.3 | 8.1217 | 0.043 67 | 4989.7 | 7.9276 | 0.032 73 | 4979.3 | 7.7879 | **1150** |
| **1175** | 0.066 75 | 5065.8 | 8.1674 | 0.044 48 | 5055.8 | 7.9736 | 0.033 34 | 5045.9 | 7.8343 | **1175** |
| **1200** | 0.067 94 | 5131.6 | 8.2124 | 0.045 28 | 5122.1 | 8.0190 | 0.033 95 | 5112.7 | 7.8800 | **1200** |
| **1225** | 0.069 12 | 5197.7 | 8.2569 | 0.046 08 | 5188.7 | 8.0639 | 0.034 56 | 5179.8 | 7.9252 | **1225** |
| **1250** | 0.070 30 | 5264.2 | 8.3009 | 0.046 88 | 5255.6 | 8.1081 | 0.035 16 | 5247.2 | 7.9698 | **1250** |
| **1275** | 0.071 49 | 5330.9 | 8.3444 | 0.047 67 | 5322.8 | 8.1519 | 0.035 77 | 5314.8 | 8.0138 | **1275** |
| **1300** | 0.072 67 | 5397.9 | 8.3873 | 0.048 47 | 5390.2 | 8.1951 | 0.036 37 | 5382.6 | 8.0573 | **1300** |
| **1325** | 0.073 84 | 5465.2 | 8.4297 | 0.049 26 | 5457.9 | 8.2378 | 0.036 97 | 5450.7 | 8.1002 | **1325** |
| **1350** | 0.075 02 | 5532.8 | 8.4717 | 0.050 05 | 5525.9 | 8.2800 | 0.037 57 | 5519.0 | 8.1426 | **1350** |
| **1375** | 0.076 20 | 5600.6 | 8.5132 | 0.050 85 | 5594.1 | 8.3217 | 0.038 17 | 5587.6 | 8.1846 | **1375** |
| **1400** | 0.077 37 | 5668.8 | 8.5542 | 0.051 64 | 5662.6 | 8.3629 | 0.038 77 | 5656.4 | 8.2260 | **1400** |
| **1425** | 0.078 55 | 5737.2 | 8.5948 | 0.052 43 | 5731.3 | 8.4037 | 0.039 37 | 5725.5 | 8.2670 | **1425** |
| **1450** | 0.079 72 | 5805.8 | 8.6349 | 0.053 22 | 5800.3 | 8.4440 | 0.039 96 | 5794.8 | 8.3075 | **1450** |
| **1475** | 0.080 89 | 5874.8 | 8.6746 | 0.054 00 | 5869.5 | 8.4839 | 0.040 56 | 5864.3 | 8.3475 | **1475** |
| **1500** | 0.082 06 | 5943.9 | 8.7139 | 0.054 79 | 5939.0 | 8.5234 | 0.041 15 | 5934.0 | 8.3871 | **1500** |
| **1525** | 0.083 24 | 6013.4 | 8.7528 | 0.055 58 | 6008.7 | 8.5624 | 0.041 75 | 6004.0 | 8.4263 | **1525** |
| **1550** | 0.084 41 | 6083.1 | 8.7913 | 0.056 36 | 6078.6 | 8.6010 | 0.042 34 | 6074.2 | 8.4651 | **1550** |
| **1575** | 0.085 58 | 6153.0 | 8.8294 | 0.057 15 | 6148.8 | 8.6392 | 0.042 93 | 6144.6 | 8.5035 | **1575** |
| **1600** | 0.086 74 | 6223.1 | 8.8671 | 0.057 93 | 6219.2 | 8.6771 | 0.043 52 | 6215.2 | 8.5414 | **1600** |
| **1650** | 0.089 08 | 6364.1 | 8.9414 | 0.059 50 | 6360.6 | 8.7516 | 0.044 71 | 6357.1 | 8.6162 | **1650** |
| **1700** | 0.091 41 | 6506.0 | 9.0142 | 0.061 06 | 6502.9 | 8.8246 | 0.045 88 | 6499.8 | 8.6894 | **1700** |
| **1750** | 0.093 74 | 6648.8 | 9.0857 | 0.062 62 | 6646.0 | 8.8963 | 0.047 06 | 6643.4 | 8.7612 | **1750** |
| **1800** | 0.096 07 | 6792.3 | 9.1558 | 0.064 18 | 6790.0 | 8.9665 | 0.048 24 | 6787.6 | 8.8317 | **1800** |
| **1850** | 0.098 40 | 6936.7 | 9.2246 | 0.065 74 | 6934.7 | 9.0355 | 0.049 41 | 6932.7 | 8.9008 | **1850** |
| **1900** | 0.100 73 | 7081.9 | 9.2922 | 0.067 30 | 7080.1 | 9.1032 | 0.050 58 | 7078.4 | 8.9687 | **1900** |
| **1950** | 0.103 05 | 7227.8 | 9.3586 | 0.068 85 | 7226.4 | 9.1698 | 0.051 75 | 7224.9 | 9.0353 | **1950** |
| **2000** | 0.105 38 | 7374.5 | 9.4238 | 0.070 41 | 7373.3 | 9.2351 | 0.052 92 | 7372.1 | 9.1008 | **2000** |

**UNITS:** $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-4. Properties of Steam at High Temperatures (cont'd)

| t (°C) | 30 MPa | | | 40 MPa | | | 50 MPa | | | t (°C) |
|---|---|---|---|---|---|---|---|---|---|---|
| | v | h | s | v | h | s | v | h | s | |
| **500** | 0.008 690 | 3084.8 | 5.7956 | 0.005 625 | 2906.7 | 5.4746 | 0.003 889 | 2722.5 | 5.1759 | **500** |
| **525** | 0.009 469 | 3187.2 | 5.9261 | 0.006 350 | 3040.3 | 5.6448 | 0.004 541 | 2887.8 | 5.3865 | **525** |
| **550** | 0.010 175 | 3279.8 | 6.0403 | 0.006 985 | 3154.6 | 5.7859 | 0.005 118 | 3025.7 | 5.5566 | **550** |
| **575** | 0.010 829 | 3365.7 | 6.1431 | 0.007 559 | 3256.7 | 5.9080 | 0.005 636 | 3145.4 | 5.6999 | **575** |
| **600** | 0.011 444 | 3446.9 | 6.2374 | 0.008 089 | 3350.4 | 6.0170 | 0.006 109 | 3252.6 | 5.8245 | **600** |
| **625** | 0.012 029 | 3524.6 | 6.3252 | 0.008 585 | 3438.3 | 6.1162 | 0.006 547 | 3351.2 | 5.9359 | **625** |
| **650** | 0.012 590 | 3599.7 | 6.4077 | 0.009 054 | 3521.8 | 6.2079 | 0.006 957 | 3443.5 | 6.0372 | **650** |
| **675** | 0.013 130 | 3672.7 | 6.4858 | 0.009 501 | 3601.9 | 6.2935 | 0.007 346 | 3531.0 | 6.1308 | **675** |
| **700** | 0.013 654 | 3744.2 | 6.5602 | 0.009 931 | 3679.4 | 6.3743 | 0.007 718 | 3614.8 | 6.2180 | **700** |
| **725** | 0.014 164 | 3814.5 | 6.6315 | 0.010 346 | 3754.9 | 6.4508 | 0.008 074 | 3695.6 | 6.3000 | **725** |
| **750** | 0.014 662 | 3883.8 | 6.7000 | 0.010 748 | 3828.8 | 6.5239 | 0.008 417 | 3774.1 | 6.3777 | **750** |
| **775** | 0.015 150 | 3952.3 | 6.7662 | 0.011 140 | 3901.3 | 6.5940 | 0.008 750 | 3850.8 | 6.4518 | **775** |
| **800** | 0.015 629 | 4020.3 | 6.8302 | 0.011 522 | 3972.9 | 6.6614 | 0.009 073 | 3926.1 | 6.5227 | **800** |
| **825** | 0.016 100 | 4087.8 | 6.8924 | 0.011 897 | 4043.6 | 6.7266 | 0.009 389 | 4000.1 | 6.5908 | **825** |
| **850** | 0.016 564 | 4155.0 | 6.9529 | 0.012 264 | 4113.7 | 6.7897 | 0.009 697 | 4073.1 | 6.6566 | **850** |
| **875** | 0.017 022 | 4222.0 | 7.0119 | 0.012 625 | 4183.3 | 6.8510 | 0.010 000 | 4145.3 | 6.7202 | **875** |
| **900** | 0.017 475 | 4288.8 | 7.0695 | 0.012 981 | 4252.5 | 6.9106 | 0.010 297 | 4216.9 | 6.7819 | **900** |
| **925** | 0.017 922 | 4355.5 | 7.1257 | 0.013 332 | 4321.5 | 6.9687 | 0.010 589 | 4288.0 | 6.8419 | **925** |
| **950** | 0.018 366 | 4422.2 | 7.1808 | 0.013 679 | 4390.2 | 7.0255 | 0.010 876 | 4358.7 | 6.9003 | **950** |
| **975** | 0.018 805 | 4488.9 | 7.2348 | 0.014 021 | 4458.7 | 7.0810 | 0.011 160 | 4429.1 | 6.9573 | **975** |
| **1000** | 0.019 241 | 4555.7 | 7.2878 | 0.014 360 | 4527.2 | 7.1353 | 0.011 441 | 4499.3 | 7.0129 | **1000** |
| **1025** | 0.019 674 | 4622.5 | 7.3398 | 0.014 696 | 4595.6 | 7.1885 | 0.011 718 | 4569.3 | 7.0674 | **1025** |
| **1050** | 0.020 10 | 4689.4 | 7.3908 | 0.015 029 | 4664.0 | 7.2407 | 0.011 992 | 4639.2 | 7.1207 | **1050** |
| **1075** | 0.020 53 | 4756.5 | 7.4410 | 0.015 359 | 4732.5 | 7.2920 | 0.012 264 | 4709.0 | 7.1730 | **1075** |
| **1100** | 0.020 95 | 4823.7 | 7.4904 | 0.015 687 | 4801.0 | 7.3423 | 0.012 533 | 4778.8 | 7.2242 | **1100** |
| **1125** | 0.021 38 | 4891.0 | 7.5390 | 0.016 012 | 4869.5 | 7.3918 | 0.012 800 | 4848.5 | 7.2746 | **1125** |
| **1150** | 0.021 80 | 4958.6 | 7.5869 | 0.016 336 | 4938.2 | 7.4405 | 0.013 065 | 4918.3 | 7.3240 | **1150** |
| **1175** | 0.022 21 | 5026.2 | 7.6340 | 0.016 657 | 5007.0 | 7.4884 | 0.013 328 | 4988.1 | 7.3727 | **1175** |
| **1200** | 0.022 63 | 5094.1 | 7.6805 | 0.016 977 | 5075.9 | 7.5355 | 0.013 590 | 5058.0 | 7.4205 | **1200** |
| **1225** | 0.023 05 | 5162.2 | 7.7263 | 0.017 295 | 5144.9 | 7.5820 | 0.013 849 | 5128.0 | 7.4676 | **1225** |
| **1250** | 0.023 46 | 5230.5 | 7.7715 | 0.017 611 | 5214.1 | 7.6278 | 0.014 107 | 5198.1 | 7.5140 | **1250** |
| **1275** | 0.023 87 | 5298.9 | 7.8161 | 0.017 926 | 5283.4 | 7.6729 | 0.014 364 | 5268.2 | 7.5597 | **1275** |
| **1300** | 0.024 28 | 5367.6 | 7.8601 | 0.018 239 | 5352.9 | 7.7175 | 0.014 620 | 5338.5 | 7.6047 | **1300** |
| **1325** | 0.024 69 | 5436.5 | 7.9035 | 0.018 552 | 5422.5 | 7.7614 | 0.014 874 | 5408.9 | 7.6492 | **1325** |
| **1350** | 0.025 10 | 5505.5 | 7.9464 | 0.018 863 | 5492.3 | 7.8047 | 0.015 127 | 5479.5 | 7.6929 | **1350** |
| **1375** | 0.025 50 | 5574.8 | 7.9888 | 0.019 173 | 5562.3 | 7.8475 | 0.015 379 | 5550.1 | 7.7362 | **1375** |
| **1400** | 0.025 91 | 5644.3 | 8.0306 | 0.019 482 | 5632.5 | 7.8898 | 0.015 630 | 5620.9 | 7.7788 | **1400** |
| **1425** | 0.026 31 | 5714.0 | 8.0720 | 0.019 790 | 5702.8 | 7.9315 | 0.015 880 | 5691.9 | 7.8209 | **1425** |
| **1450** | 0.026 72 | 5783.9 | 8.1129 | 0.020 10 | 5773.3 | 7.9727 | 0.016 129 | 5763.0 | 7.8625 | **1450** |
| **1475** | 0.027 12 | 5854.0 | 8.1532 | 0.020 40 | 5844.0 | 8.0134 | 0.016 378 | 5834.3 | 7.9035 | **1475** |
| **1500** | 0.027 52 | 5924.3 | 8.1932 | 0.020 71 | 5914.9 | 8.0537 | 0.016 625 | 5905.7 | 7.9441 | **1500** |
| **1525** | 0.027 92 | 5994.8 | 8.2327 | 0.021 01 | 5985.9 | 8.0935 | 0.016 872 | 5977.2 | 7.9841 | **1525** |
| **1550** | 0.028 32 | 6065.6 | 8.2717 | 0.021 32 | 6057.1 | 8.1328 | 0.017 118 | 6048.9 | 8.0237 | **1550** |
| **1575** | 0.028 72 | 6136.5 | 8.3103 | 0.021 62 | 6128.5 | 8.1717 | 0.017 364 | 6120.8 | 8.0629 | **1575** |
| **1600** | 0.029 12 | 6207.6 | 8.3486 | 0.021 92 | 6200.1 | 8.2101 | 0.017 609 | 6192.8 | 8.1016 | **1600** |
| **1650** | 0.029 92 | 6350.3 | 8.4238 | 0.022 53 | 6343.7 | 8.2858 | 0.018 097 | 6337.3 | 8.1777 | **1650** |
| **1700** | 0.030 71 | 6493.8 | 8.4975 | 0.023 13 | 6488.0 | 8.3599 | 0.018 582 | 6482.4 | 8.2522 | **1700** |
| **1750** | 0.031 51 | 6638.1 | 8.5697 | 0.023 73 | 6633.0 | 8.4325 | 0.019 066 | 6628.1 | 8.3252 | **1750** |
| **1800** | 0.032 30 | 6783.1 | 8.6404 | 0.024 33 | 6778.7 | 8.5036 | 0.019 549 | 6774.5 | 8.3966 | **1800** |
| **1850** | 0.033 08 | 6928.8 | 8.7099 | 0.024 92 | 6925.0 | 8.5733 | 0.020 03 | 6921.4 | 8.4666 | **1850** |
| **1900** | 0.033 87 | 7075.1 | 8.7780 | 0.025 52 | 7072.0 | 8.6417 | 0.020 51 | 7068.9 | 8.5353 | **1900** |
| **1950** | 0.034 66 | 7222.2 | 8.8449 | 0.026 11 | 7219.5 | 8.7089 | 0.020 99 | 7217.1 | 8.6027 | **1950** |
| **2000** | 0.035 44 | 7369.9 | 8.9106 | 0.026 70 | 7367.8 | 8.7748 | 0.021 46 | 7365.8 | 8.6689 | **2000** |

**UNITS**: $v$ in $m^3/kg$ ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

## Table T-5. Properties of Superheated and Metastable Steam

| | 0.01 MPa ($t_{sat}$ = 45.81 °C) | | | 0.02 MPa ($t_{sat}$ = 60.06 °C) | | | 0.04 MPa ($t_{sat}$ = 75.86 °C) | | | 0.06 MPa ($t_{sat}$ = 85.93 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Vap. | 14.671 | 2583.9 | 8.1489 | 7.6482 | 2608.9 | 7.9072 | 3.9931 | 2636.1 | 7.6690 | 2.7318 | 2652.9 | 7.5311 | Sat. Vap. |
| **90** | 16.732 | 2668.4 | 8.3970 | 8.3520 | 2667.0 | 8.0740 | 4.1616 | 2664.1 | 7.7477 | 2.7646 | 2661.1 | 7.5539 | **90** |
| **85** | 16.500 | 2658.9 | 8.3706 | 8.2350 | 2657.3 | 8.0473 | 4.1022 | 2654.2 | 7.7203 | 2.7243 | 2651.0 | 7.5259 | **85** |
| **80** | 16.267 | 2649.3 | 8.3438 | 8.1178 | 2647.7 | 8.0202 | 4.0427 | 2644.3 | 7.6925 | 2.6838 | 2640.7 | 7.4971 | **80** |
| **75** | 16.035 | 2639.8 | 8.3167 | 8.0004 | 2638.0 | 7.9926 | 3.9828 | 2634.4 | 7.6641 | 2.6430 | 2630.4 | 7.4675 | **75** |
| **70** | 15.802 | 2630.3 | 8.2891 | 7.8828 | 2628.3 | 7.9646 | 3.9227 | 2624.3 | 7.6349 | 2.6020 | 2619.9 | 7.4371 | **70** |
| **65** | 15.569 | 2620.7 | 8.2611 | 7.7650 | 2618.6 | 7.9361 | 3.8623 | 2614.1 | 7.6051 | 2.5605 | 2609.2 | 7.4058 | **65** |
| **60** | 15.335 | 2611.2 | 8.2326 | 7.6467 | 2608.9 | 7.9069 | 3.8015 | 2603.8 | 7.5743 | 2.5187 | 2598.3 | 7.3732 | **60** |
| **55** | 15.102 | 2601.6 | 8.2037 | 7.5281 | 2599.0 | 7.8771 | 3.7402 | 2593.3 | 7.5427 | 2.4762 | 2587.1 | 7.3393 | **55** |
| **50** | 14.867 | 2592.0 | 8.1741 | 7.4090 | 2589.1 | 7.8466 | 3.6784 | 2582.7 | 7.5100 | 2.4331 | 2575.5 | 7.3037 | **50** |
| **45** | 14.632 | 2582.3 | 8.1440 | 7.2894 | 2579.0 | 7.8153 | 3.6159 | 2571.7 | 7.4759 | 2.3890 | 2563.4 | 7.2661 | **45** |
| **40** | 14.397 | 2572.6 | 8.1132 | 7.1692 | 2568.9 | 7.7831 | 3.5525 | 2560.5 | 7.4403 | 2.3438 | 2550.7 | 7.2258 | **40** |
| **35** | 14.161 | 2562.8 | 8.0816 | 7.0481 | 2558.5 | 7.7499 | 3.4879 | 2548.8 | 7.4027 | *2.2970* | *2537.1* | *7.1822* | **35** |
| **30** | 13.924 | 2552.9 | 8.0493 | 6.9259 | 2548.0 | 7.7154 | 3.4219 | 2536.6 | 7.3626 | | | | **30** |
| **25** | 13.686 | 2543.0 | 8.0161 | 6.8025 | 2537.2 | 7.6795 | 3.3540 | 2523.6 | 7.3193 | | | | **25** |
| **20** | 13.447 | 2532.8 | 7.9819 | 6.6773 | 2526.1 | 7.6419 | *3.2835* | *2509.6* | *7.2720* | | | | **20** |
| **15** | 13.206 | 2522.5 | 7.9464 | 6.5500 | 2514.5 | 7.6020 | | | | | | | **15** |
| **10** | 12.962 | 2512.0 | 7.9095 | 6.4197 | 2502.3 | 7.5592 | | | | | | | **10** |
| **5** | 12.716 | 2501.1 | 7.8708 | *6.2855* | *2489.2* | *7.5128* | | | | | | | **5** |
| **0** | 12.466 | 2489.8 | 7.8299 | | | | | | | | | | **0** |
| **-5** | 12.211 | 2478.0 | 7.7861 | | | | | | | | | | **-5** |
| **-10** | 11.950 | 2465.4 | 7.7387 | | | | | | | | | | **-10** |
| **-15** | *11.679* | *2451.8* | *7.6864* | | | | | | | | | | **-15** |

| | 0.08 MPa ($t_{sat}$ = 93.49 °C) | | | 0.10 MPa ($t_{sat}$ = 99.61 °C) | | | 0.12 MPa ($t_{sat}$ = 104.78 °C) | | | 0.14 MPa ($t_{sat}$ = 109.29 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Vap. | 2.0872 | 2665.2 | 7.4339 | 1.6940 | 2674.9 | 7.3588 | 1.4284 | 2683.1 | 7.2976 | 1.2366 | 2690.0 | 7.2460 | Sat. Vap. |
| **110** | 2.1871 | 2698.7 | 7.5232 | 1.7448 | 2696.3 | 7.4154 | 1.4499 | 2693.9 | 7.3262 | 1.2392 | 2691.5 | 7.2499 | **110** |
| **105** | 2.1570 | 2688.6 | 7.4968 | 1.7205 | 2686.1 | 7.3885 | 1.4293 | 2683.5 | 7.2988 | 1.2212 | 2680.8 | 7.2218 | **105** |
| **100** | 2.1268 | 2678.5 | 7.4698 | 1.6960 | 2675.8 | 7.3610 | 1.4085 | 2672.9 | 7.2706 | 1.2031 | 2669.9 | 7.1929 | **100** |
| **95** | 2.0964 | 2668.3 | 7.4423 | 1.6712 | 2665.3 | 7.3328 | 1.3876 | 2662.1 | 7.2416 | 1.1849 | 2658.9 | 7.1631 | **95** |
| **90** | 2.0658 | 2658.0 | 7.4142 | 1.6463 | 2654.7 | 7.3037 | 1.3664 | 2651.2 | 7.2116 | 1.1664 | 2647.6 | 7.1322 | **90** |
| **85** | 2.0350 | 2647.5 | 7.3852 | 1.6212 | 2643.9 | 7.2738 | 1.3451 | 2640.0 | 7.1807 | 1.1476 | 2636.0 | 7.1000 | **85** |
| **80** | 2.0040 | 2636.9 | 7.3554 | 1.5958 | 2632.9 | 7.2428 | 1.3234 | 2628.6 | 7.1485 | 1.1285 | 2624.0 | 7.0663 | **80** |
| **75** | 1.9727 | 2626.1 | 7.3246 | 1.5701 | 2621.6 | 7.2107 | 1.3013 | 2616.8 | 7.1148 | 1.1089 | 2611.5 | 7.0308 | **75** |
| **70** | 1.9410 | 2615.1 | 7.2928 | 1.5439 | 2610.0 | 7.1772 | 1.2787 | 2604.5 | 7.0792 | 1.0888 | 2598.5 | 6.9930 | **70** |
| **65** | 1.9089 | 2603.8 | 7.2596 | 1.5173 | 2598.0 | 7.1419 | 1.2556 | 2591.6 | 7.0415 | 1.0680 | 2584.6 | 6.9523 | **65** |
| **60** | 1.8763 | 2592.2 | 7.2249 | 1.4900 | 2585.5 | 7.1045 | 1.2316 | 2578.0 | 7.0008 | *1.0463* | *2569.7* | *6.9078* | **60** |
| **55** | 1.8430 | 2580.1 | 7.1882 | 1.4619 | 2572.2 | 7.0644 | *1.2067* | *2563.3* | *6.9565* | | | | **55** |
| **50** | 1.8088 | 2567.3 | 7.1490 | *1.4326* | *2558.0* | *7.0207* | | | | | | | **50** |
| **45** | 1.7734 | 2553.7 | 7.1067 | | | | | | | | | | **45** |
| **40** | *1.7365* | *2539.1* | *7.0604* | | | | | | | | | | **40** |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

**NOTE:** *Points in italics are extrapolations beyond 5 % equilibrium moisture limit; see Chapter 3.*

## Table T-5. Properties of Superheated and Metastable Steam (cont'd)

| | 0.16 MPa ($t_{sat}$ = 113.30 °C) | | | 0.18 MPa ($t_{sat}$ = 116.91 °C) | | | 0.20 MPa ($t_{sat}$ = 120.21 °C) | | | 0.22 MPa ($t_{sat}$ = 123.25 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Vap. | 1.0914 | 2696.0 | 7.2014 | 0.9775 | 2701.4 | 7.1620 | 0.8857 | 2706.2 | 7.1269 | 0.8101 | 2710.6 | 7.0951 | Sat. Vap. |
| **125** | 1.1278 | 2720.7 | 7.2643 | 1.0001 | 2718.7 | 7.2058 | 0.8979 | 2716.6 | 7.1530 | 0.8142 | 2714.4 | 7.1047 | **125** |
| **120** | 1.1123 | 2710.3 | 7.2378 | 0.9862 | 2708.0 | 7.1790 | 0.8851 | 2705.8 | 7.1256 | 0.8025 | 2703.4 | 7.0767 | **120** |
| **115** | 1.0968 | 2699.7 | 7.2107 | 0.9721 | 2697.2 | 7.1513 | 0.8723 | 2694.7 | 7.0974 | 0.7906 | 2692.1 | 7.0479 | **115** |
| **110** | 1.0810 | 2688.9 | 7.1828 | 0.9579 | 2686.2 | 7.1228 | 0.8594 | 2683.5 | 7.0682 | 0.7787 | 2680.6 | 7.0181 | **110** |
| **105** | 1.0651 | 2678.0 | 7.1541 | 0.9435 | 2675.0 | 7.0933 | 0.8462 | 2672.0 | 7.0381 | 0.7665 | 2668.8 | 6.9872 | **105** |
| **100** | 1.0490 | 2666.8 | 7.1244 | 0.9290 | 2663.6 | 7.0629 | 0.8329 | 2660.2 | 7.0067 | 0.7542 | 2656.7 | 6.9549 | **100** |
| **95** | 1.0327 | 2655.4 | 7.0937 | 0.9142 | 2651.8 | 7.0312 | 0.8193 | 2648.1 | 6.9740 | 0.7415 | 2644.1 | 6.9209 | **95** |
| **90** | 1.0161 | 2643.7 | 7.0617 | 0.8991 | 2639.7 | 6.9980 | 0.8054 | 2635.5 | 6.9395 | 0.7285 | 2631.0 | 6.8850 | **90** |
| **85** | 0.9993 | 2631.7 | 7.0282 | 0.8837 | 2627.1 | 6.9630 | 0.7911 | 2622.3 | 6.9029 | 0.7151 | 2617.1 | 6.8466 | **85** |
| **80** | 0.9820 | 2619.1 | 6.9929 | 0.8679 | 2613.9 | 6.9259 | 0.7763 | 2608.3 | 6.8636 | 0.7011 | 2602.3 | 6.8050 | **80** |
| **75** | 0.9643 | 2605.9 | 6.9553 | 0.8515 | 2599.9 | 6.8859 | *0.7609* | *2593.4* | *6.8210* | *0.6865* | *2586.3* | *6.7593* | **75** |
| **70** | 0.9459 | 2591.9 | 6.9149 | *0.8343* | *2584.8* | *6.8424* | | | | | | | **70** |
| **65** | *0.9267* | *2576.9* | *6.8707* | | | | | | | | | | **65** |

| | 0.25 MPa ($t_{sat}$ = 127.41 °C) | | | 0.30 MPa ($t_{sat}$ = 133.53 °C) | | | 0.35 MPa ($t_{sat}$ = 138.86 °C) | | | 0.40 MPa ($t_{sat}$ = 143.61 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Vap. | 0.7187 | 2716.5 | 7.0524 | 0.6058 | 2724.9 | 6.9916 | 0.5242 | 2732.0 | 6.9401 | 0.4624 | 2738.1 | 6.8954 | Sat. Vap. |
| **145** | 0.7544 | 2754.6 | 7.1455 | 0.6255 | 2750.3 | 7.0533 | 0.5334 | 2745.9 | 6.9737 | 0.4643 | 2741.3 | 6.9032 | **145** |
| **140** | 0.7444 | 2743.9 | 7.1198 | 0.6170 | 2739.4 | 7.0269 | 0.5259 | 2734.6 | 6.9464 | 0.4575 | 2729.5 | 6.8747 | **140** |
| **135** | 0.7342 | 2733.1 | 7.0935 | 0.6084 | 2728.2 | 6.9997 | 0.5183 | 2722.9 | 6.9181 | 0.4506 | 2717.4 | 6.8453 | **135** |
| **130** | 0.7240 | 2722.2 | 7.0666 | 0.5995 | 2716.8 | 6.9716 | 0.5105 | 2711.0 | 6.8888 | 0.4436 | 2705.0 | 6.8147 | **130** |
| **125** | 0.7136 | 2711.1 | 7.0388 | 0.5907 | 2705.1 | 6.9425 | 0.5027 | 2698.8 | 6.8583 | 0.4365 | 2692.2 | 6.7828 | **125** |
| **120** | 0.7032 | 2699.7 | 7.0101 | 0.5816 | 2693.2 | 6.9123 | 0.4946 | 2686.3 | 6.8266 | 0.4292 | 2678.9 | 6.7491 | **120** |
| **115** | 0.6926 | 2688.1 | 6.9803 | 0.5725 | 2680.9 | 6.8809 | 0.4864 | 2673.2 | 6.7932 | 0.4217 | 2664.9 | 6.7135 | **115** |
| **110** | 0.6818 | 2676.2 | 6.9495 | 0.5631 | 2668.3 | 6.8480 | 0.4780 | 2659.6 | 6.7579 | 0.4139 | 2650.2 | 6.6754 | **110** |
| **105** | 0.6708 | 2663.9 | 6.9172 | 0.5534 | 2655.0 | 6.8133 | 0.4692 | 2645.3 | 6.7202 | 0.4057 | 2634.6 | 6.6342 | **105** |
| **100** | 0.6595 | 2651.2 | 6.8834 | 0.5435 | 2641.1 | 6.7763 | 0.4601 | 2630.0 | 6.6795 | *0.3972* | *2617.6* | *6.5890* | **100** |
| **95** | 0.6480 | 2637.9 | 6.8475 | 0.5332 | 2626.4 | 6.7366 | *0.4506* | *2613.5* | *6.6350* | | | | **95** |
| **90** | 0.6360 | 2623.8 | 6.8091 | *0.5224* | *2610.6* | *6.6933* | | | | | | | **90** |
| **85** | 0.6236 | 2608.9 | 6.7675 | | | | | | | | | | **85** |
| **80** | *0.6105* | *2592.6* | *6.7219* | | | | | | | | | | **80** |

| | 0.5 MPa ($t_{sat}$ = 151.84 °C) | | | 0.6 MPa ($t_{sat}$ = 158.83 °C) | | | 0.7 MPa ($t_{sat}$ = 164.95 °C) | | | 0.8 MPa ($t_{sat}$ = 170.41 °C) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $t$ (°C) |
| Sat. Vap. | 0.3748 | 2748.1 | 6.8206 | 0.3156 | 2756.1 | 6.7592 | 0.2728 | 2762.7 | 6.7070 | 0.2403 | 2768.3 | 6.6615 | Sat. Vap. |
| **175** | 0.3995 | 2801.4 | 6.9427 | 0.3303 | 2794.6 | 6.8466 | 0.2808 | 2787.5 | 6.7628 | 0.2436 | 2780.0 | 6.6878 | **175** |
| **170** | 0.3943 | 2790.2 | 6.9176 | 0.3258 | 2783.0 | 6.8205 | 0.2769 | 2775.4 | 6.7356 | 0.2400 | 2767.2 | 6.6591 | **170** |
| **165** | 0.3890 | 2778.9 | 6.8919 | 0.3213 | 2771.1 | 6.7936 | 0.2728 | 2762.9 | 6.7073 | 0.2363 | 2754.0 | 6.6291 | **165** |
| **160** | 0.3837 | 2767.4 | 6.8655 | 0.3167 | 2759.0 | 6.7658 | 0.2687 | 2750.0 | 6.6776 | 0.2326 | 2740.3 | 6.5977 | **160** |
| **155** | 0.3783 | 2755.7 | 6.8383 | 0.3120 | 2746.5 | 6.7368 | 0.2644 | 2736.7 | 6.6468 | 0.2287 | 2726.1 | 6.5647 | **155** |
| **150** | 0.3728 | 2743.6 | 6.8100 | 0.3072 | 2733.6 | 6.7066 | 0.2601 | 2722.9 | 6.6144 | 0.2247 | 2711.3 | 6.5299 | **150** |
| **145** | 0.3672 | 2731.3 | 6.7806 | 0.3022 | 2720.4 | 6.6750 | 0.2557 | 2708.6 | 6.5803 | 0.2205 | 2695.7 | 6.4928 | **145** |
| **140** | 0.3615 | 2718.6 | 6.7501 | 0.2972 | 2706.6 | 6.6419 | 0.2510 | 2693.5 | 6.5441 | 0.2162 | 2679.1 | 6.4530 | **140** |
| **135** | 0.3557 | 2705.4 | 6.7181 | 0.2920 | 2692.2 | 6.6068 | 0.2462 | 2677.6 | 6.5053 | *0.2116* | *2661.4* | *6.4097* | **135** |
| **130** | 0.3497 | 2691.8 | 6.6845 | 0.2866 | 2677.0 | 6.5694 | 0.2412 | 2660.5 | 6.4633 | | | | **130** |
| **125** | 0.3435 | 2677.5 | 6.6488 | 0.2810 | 2660.9 | 6.5292 | *0.2359* | *2642.1* | *6.4173* | | | | **125** |
| **120** | 0.3371 | 2662.4 | 6.6107 | *0.2751* | *2643.5* | *6.4853* | | | | | | | **120** |
| **115** | 0.3304 | 2646.3 | 6.5695 | | | | | | | | | | **115** |
| **110** | *0.3234* | *2628.9* | *6.5243* | | | | | | | | | | **110** |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

**NOTE:** *Points in italics are extrapolations beyond 5 % equilibrium moisture limit; see Chapter 3.*

## Table T-5. Properties of Superheated and Metastable Steam (cont'd)

| $t$ (°C) | 1.0 MPa ($t_{sat}$ = 179.89 °C) | | | 1.2 MPa ($t_{sat}$ = 187.96 °C) | | | 1.4 MPa ($t_{sat}$ = 195.05 °C) | | | 1.6 MPa ($t_{sat}$ = 201.38 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| Sat. Vap. | 0.1943 | 2777.1 | 6.5850 | 0.1632 | 2783.8 | 6.5217 | 0.1408 | 2788.9 | 6.4675 | 0.1237 | 2792.9 | 6.4200 | Sat. Vap. |
| 205 | 0.2088 | 2840.3 | 6.7208 | 0.1718 | 2828.8 | 6.6177 | 0.1452 | 2816.6 | 6.5262 | 0.1252 | 2803.6 | 6.4425 | 205 |
| 200 | 0.2060 | 2828.3 | 6.6955 | 0.1693 | 2816.1 | 6.5908 | 0.1430 | 2803.0 | 6.4975 | 0.1232 | 2788.7 | 6.4113 | 200 |
| 195 | 0.2032 | 2816.0 | 6.6695 | 0.1668 | 2803.0 | 6.5630 | 0.1408 | 2788.8 | 6.4673 | 0.1211 | 2773.3 | 6.3784 | 195 |
| 190 | 0.2003 | 2803.5 | 6.6426 | 0.1643 | 2789.4 | 6.5340 | 0.1384 | 2774.0 | 6.4354 | 0.1189 | 2757.1 | 6.3437 | 190 |
| 185 | 0.1974 | 2790.7 | 6.6148 | 0.1617 | 2775.4 | 6.5034 | 0.1360 | 2758.5 | 6.4020 | 0.1166 | 2740.2 | 6.3069 | 185 |
| 180 | 0.1944 | 2777.4 | 6.5857 | 0.1590 | 2760.7 | 6.4713 | 0.1335 | 2742.4 | 6.3666 | 0.1142 | 2722.2 | 6.2675 | 180 |
| 175 | 0.1914 | 2763.7 | 6.5551 | 0.1563 | 2745.5 | 6.4375 | 0.1310 | 2725.4 | 6.3289 | 0.1117 | 2703.1 | 6.2251 | 175 |
| 170 | 0.1882 | 2749.4 | 6.5232 | 0.1534 | 2729.6 | 6.4018 | 0.1283 | 2707.4 | 6.2884 | *0.1091* | *2682.5* | *6.1790* | 170 |
| 165 | 0.1850 | 2734.6 | 6.4895 | 0.1504 | 2712.7 | 6.3636 | *0.1254* | *2688.1* | *6.2446* | | | | 165 |
| 160 | 0.1817 | 2719.1 | 6.4539 | 0.1473 | 2694.9 | 6.3225 | | | | | | | 160 |
| 155 | 0.1782 | 2702.7 | 6.4158 | *0.1440* | *2675.6* | *6.2779* | | | | | | | 155 |
| 150 | 0.1746 | 2685.2 | 6.3748 | | | | | | | | | | 150 |
| 145 | *0.1707* | *2666.5* | *6.3302* | | | | | | | | | | 145 |

| $t$ (°C) | 2.0 MPa ($t_{sat}$ = 212.38 °C) | | | 2.5 MPa ($t_{sat}$ = 223.96 °C) | | | 3.0 MPa ($t_{sat}$ = 233.86 °C) | | | 4.0 MPa ($t_{sat}$ = 250.36 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| Sat. Vap. | 0.099 58 | 2798.4 | 6.3392 | 0.079 95 | 2802.0 | 6.2560 | 0.066 66 | 2803.3 | 6.1858 | 0.049 78 | 2800.9 | 6.0697 | Sat. Vap. |
| 255 | 0.1130 | 2915.9 | 6.5716 | 0.088 31 | 2894.7 | 6.4369 | 0.071 77 | 2871.7 | 6.3181 | 0.050 76 | 2818.9 | 6.1040 | 255 |
| 250 | 0.1115 | 2903.2 | 6.5474 | 0.087 04 | 2880.9 | 6.4106 | 0.070 62 | 2856.5 | 6.2893 | 0.049 70 | 2799.5 | 6.0669 | 250 |
| 245 | 0.1100 | 2890.3 | 6.5226 | 0.085 75 | 2866.8 | 6.3836 | 0.069 44 | 2840.9 | 6.2592 | 0.048 58 | 2778.7 | 6.0271 | 245 |
| 240 | 0.1085 | 2877.2 | 6.4972 | 0.084 44 | 2852.3 | 6.3555 | 0.068 23 | 2824.6 | 6.2275 | 0.047 39 | 2756.6 | 5.9842 | 240 |
| 235 | 0.1070 | 2863.8 | 6.4710 | 0.083 09 | 2837.4 | 6.3263 | 0.066 96 | 2807.4 | 6.1938 | 0.046 13 | 2732.7 | 5.9375 | 235 |
| 230 | 0.1054 | 2850.2 | 6.4440 | 0.081 70 | 2821.9 | 6.2956 | 0.065 64 | 2789.1 | 6.1578 | *0.044 77* | *2706.9* | *5.8863* | 230 |
| 225 | 0.1038 | 2836.1 | 6.4160 | 0.080 26 | 2805.6 | 6.2631 | 0.064 26 | 2769.9 | 6.1193 | | | | 225 |
| 220 | 0.1022 | 2821.7 | 6.3868 | 0.078 76 | 2788.4 | 6.2284 | 0.062 81 | 2749.5 | 6.0782 | | | | 220 |
| 215 | 0.1005 | 2806.6 | 6.3560 | 0.077 20 | 2770.3 | 6.1916 | 0.061 27 | 2727.6 | 6.0337 | | | | 215 |
| 210 | 0.098 75 | 2790.7 | 6.3234 | 0.075 57 | 2751.3 | 6.1524 | *0.059 64* | *2704.1* | *5.9852* | | | | 210 |
| 205 | 0.096 95 | 2774.2 | 6.2889 | 0.073 86 | 2731.0 | 6.1102 | | | | | | | 205 |
| 200 | 0.095 07 | 2756.8 | 6.2523 | *0.072 04* | *2709.3* | *6.0645* | | | | | | | 200 |
| 195 | 0.093 12 | 2738.4 | 6.2133 | | | | | | | | | | 195 |
| 190 | 0.091 07 | 2718.9 | 6.1713 | | | | | | | | | | 190 |
| 185 | *0.088 90* | *2697.9* | *6.1259* | | | | | | | | | | 185 |

| $t$ (°C) | 5 MPa ($t_{sat}$ = 263.94 °C) | | | 6 MPa ($t_{sat}$ = 275.59 °C) | | | 8 MPa ($t_{sat}$ = 295.01 °C) | | | 10 MPa ($t_{sat}$ = 311.00 °C) | | | $t$ (°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | $v$ | $h$ | $s$ | |
| Sat. Vap. | 0.039 45 | 2794.2 | 5.9737 | 0.032 45 | 2784.6 | 5.8901 | 0.023 53 | 2758.6 | 5.7448 | 0.018 03 | 2725.5 | 5.6159 | Sat. Vap. |
| 315 | 0.047 45 | 2971.5 | 6.2900 | 0.038 16 | 2937.3 | 6.1595 | 0.026 25 | 2857.4 | 5.9159 | 0.018 61 | 2752.4 | 5.6619 | 315 |
| 310 | 0.046 77 | 2956.6 | 6.2645 | 0.037 52 | 2920.6 | 6.1309 | 0.025 63 | 2835.3 | 5.8781 | 0.017 88 | 2718.3 | 5.6036 | 310 |
| 305 | 0.046 06 | 2941.3 | 6.2381 | 0.036 87 | 2903.3 | 6.1012 | 0.024 98 | 2811.7 | 5.8375 | 0.017 06 | 2679.2 | 5.5362 | 305 |
| 300 | 0.045 35 | 2925.6 | 6.2109 | 0.036 19 | 2885.5 | 6.0702 | 0.024 28 | 2786.4 | 5.7935 | *0.016 11* | *2633.7* | *5.4572* | 300 |
| 295 | 0.044 61 | 2909.6 | 6.1828 | 0.035 49 | 2866.9 | 6.0377 | 0.023 53 | 2758.6 | 5.7447 | | | | 295 |
| 290 | 0.043 86 | 2893.0 | 6.1535 | 0.034 76 | 2847.5 | 6.0033 | 0.022 70 | 2727.3 | 5.6896 | | | | 290 |
| 285 | 0.043 08 | 2875.9 | 6.1229 | 0.034 00 | 2827.0 | 5.9668 | 0.021 77 | 2692.2 | 5.6268 | | | | 285 |
| 280 | 0.042 27 | 2858.1 | 6.0909 | 0.033 20 | 2805.2 | 5.9276 | *0.020 73* | *2652.1* | *5.5547* | | | | 280 |
| 275 | 0.041 44 | 2839.5 | 6.0571 | 0.032 34 | 2781.7 | 5.8849 | | | | | | | 275 |
| 270 | 0.040 57 | 2819.8 | 6.0211 | 0.031 42 | 2756.0 | 5.8377 | | | | | | | 270 |
| 265 | 0.039 65 | 2798.9 | 5.9823 | 0.030 43 | 2727.8 | 5.7855 | | | | | | | 265 |
| 260 | 0.038 67 | 2776.3 | 5.9401 | *0.029 34* | *2696.6* | *5.7273* | | | | | | | 260 |
| 255 | 0.037 63 | 2751.9 | 5.8942 | | | | | | | | | | 255 |
| 250 | 0.036 50 | 2725.3 | 5.8437 | | | | | | | | | | 250 |
| 245 | *0.035 28* | *2696.2* | *5.7878* | | | | | | | | | | 245 |

**UNITS:** $v$ in m$^3$/kg ; $h$ in kJ/kg ; $s$ in kJ/(kg·K)

**NOTE:** *Points in italics are extrapolations beyond 5 % equilibrium moisture limit; see Chapter 3.*

## Table T-6. Isobaric Heat Capacity of Water and Steam (kJ.kg$^{-1}$.K$^{-1}$)

| | Pressure (MPa) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $t$ (°C) | 0.01 | 0.02 | 0.05 | 0.1 | 0.2 | 0.5 | 1 | 2 | 5 | 10 | 20 | 50 | 75 | 100 |
| Sat. Liq. | 4.179 | 4.183 | 4.197 | 4.216 | 4.247 | 4.315 | 4.405 | 4.562 | 5.032 | 6.127 | 23.20 | | | |
| Sat. Vap. | 1.941 | 1.966 | 2.016 | 2.076 | 2.175 | 2.413 | 2.715 | 3.190 | 4.438 | 7.147 | 45.68 | | | |
| **0** | 4.220 | 4.220 | 4.220 | 4.219 | 4.219 | 4.217 | 4.215 | 4.210 | 4.196 | 4.172 | 4.129 | 4.022 | 3.956 | 3.906 |
| **10** | 4.196 | 4.196 | 4.196 | 4.195 | 4.195 | 4.194 | 4.192 | 4.188 | 4.177 | 4.160 | 4.126 | 4.042 | 3.988 | 3.945 |
| **20** | 4.185 | 4.185 | 4.185 | 4.185 | 4.184 | 4.184 | 4.182 | 4.179 | 4.170 | 4.155 | 4.127 | 4.056 | 4.008 | 3.969 |
| **25** | 4.182 | 4.182 | 4.182 | 4.182 | 4.182 | 4.181 | 4.179 | 4.176 | 4.168 | 4.154 | 4.128 | 4.061 | 4.016 | 3.978 |
| **30** | 4.180 | 4.180 | 4.180 | 4.180 | 4.180 | 4.179 | 4.178 | 4.175 | 4.167 | 4.154 | 4.130 | 4.066 | 4.022 | 3.985 |
| **40** | 4.179 | 4.179 | 4.179 | 4.179 | 4.178 | 4.178 | 4.176 | 4.174 | 4.167 | 4.155 | 4.133 | 4.073 | 4.032 | 3.996 |
| **50** | 1.927 | 4.180 | 4.180 | 4.180 | 4.179 | 4.179 | 4.177 | 4.175 | 4.168 | 4.157 | 4.136 | 4.080 | 4.040 | 4.005 |
| **60** | 1.912 | 4.183 | 4.183 | 4.183 | 4.183 | 4.182 | 4.181 | 4.179 | 4.172 | 4.161 | 4.141 | 4.086 | 4.047 | 4.012 |
| **70** | 1.907 | 1.940 | 4.188 | 4.188 | 4.188 | 4.187 | 4.186 | 4.184 | 4.178 | 4.167 | 4.147 | 4.093 | 4.054 | 4.019 |
| **80** | 1.905 | 1.930 | 4.196 | 4.196 | 4.195 | 4.195 | 4.194 | 4.191 | 4.185 | 4.174 | 4.154 | 4.100 | 4.061 | 4.026 |
| **90** | 1.905 | 1.925 | 1.990 | 4.205 | 4.205 | 4.204 | 4.203 | 4.201 | 4.194 | 4.184 | 4.163 | 4.108 | 4.068 | 4.033 |
| **100** | 1.906 | 1.922 | 1.973 | 2.074 | 4.216 | 4.216 | 4.215 | 4.212 | 4.206 | 4.194 | 4.173 | 4.117 | 4.076 | 4.040 |
| **110** | 1.907 | 1.921 | 1.963 | 2.040 | 4.230 | 4.230 | 4.228 | 4.226 | 4.219 | 4.207 | 4.185 | 4.127 | 4.084 | 4.047 |
| **120** | 1.910 | 1.921 | 1.956 | 2.019 | 4.246 | 4.246 | 4.244 | 4.242 | 4.234 | 4.222 | 4.199 | 4.137 | 4.093 | 4.055 |
| **130** | 1.913 | 1.922 | 1.952 | 2.004 | 2.123 | 4.264 | 4.263 | 4.260 | 4.252 | 4.239 | 4.214 | 4.149 | 4.103 | 4.063 |
| **140** | 1.916 | 1.924 | 1.949 | 1.993 | 2.090 | 4.286 | 4.284 | 4.281 | 4.273 | 4.258 | 4.232 | 4.163 | 4.114 | 4.072 |
| **150** | 1.920 | 1.927 | 1.948 | 1.986 | 2.067 | 4.310 | 4.309 | 4.305 | 4.296 | 4.281 | 4.252 | 4.177 | 4.126 | 4.081 |
| **160** | 1.924 | 1.930 | 1.949 | 1.980 | 2.049 | 2.318 | 4.337 | 4.333 | 4.323 | 4.306 | 4.274 | 4.194 | 4.139 | 4.092 |
| **170** | 1.929 | 1.934 | 1.950 | 1.977 | 2.036 | 2.250 | 4.369 | 4.365 | 4.353 | 4.334 | 4.300 | 4.212 | 4.153 | 4.103 |
| **180** | 1.934 | 1.938 | 1.952 | 1.976 | 2.026 | 2.205 | 2.712 | 4.401 | 4.388 | 4.367 | 4.328 | 4.232 | 4.169 | 4.115 |
| **190** | 1.938 | 1.942 | 1.954 | 1.975 | 2.019 | 2.171 | 2.529 | 4.443 | 4.428 | 4.404 | 4.361 | 4.255 | 4.186 | 4.129 |
| **200** | 1.944 | 1.947 | 1.958 | 1.976 | 2.014 | 2.145 | 2.429 | 4.491 | 4.474 | 4.447 | 4.398 | 4.281 | 4.205 | 4.144 |
| **220** | 1.954 | 1.957 | 1.965 | 1.979 | 2.009 | 2.108 | 2.310 | 2.949 | 4.590 | 4.553 | 4.489 | 4.341 | 4.250 | 4.179 |
| **240** | 1.965 | 1.968 | 1.974 | 1.985 | 2.009 | 2.086 | 2.238 | 2.648 | 4.749 | 4.697 | 4.608 | 4.417 | 4.306 | 4.221 |
| **260** | 1.977 | 1.979 | 1.984 | 1.993 | 2.012 | 2.073 | 2.191 | 2.491 | 4.976 | 4.897 | 4.769 | 4.512 | 4.373 | 4.271 |
| **280** | 1.989 | 1.990 | 1.995 | 2.002 | 2.018 | 2.067 | 2.160 | 2.389 | 3.635 | 5.193 | 4.991 | 4.631 | 4.455 | 4.331 |
| **300** | 2.001 | 2.002 | 2.006 | 2.012 | 2.025 | 2.066 | 2.141 | 2.320 | 3.171 | 5.682 | 5.317 | 4.782 | 4.553 | 4.400 |
| **320** | 2.013 | 2.014 | 2.017 | 2.023 | 2.034 | 2.068 | 2.130 | 2.273 | 2.903 | 5.747 | 5.849 | 4.974 | 4.669 | 4.478 |
| **340** | 2.026 | 2.026 | 2.029 | 2.034 | 2.043 | 2.072 | 2.124 | 2.242 | 2.727 | 4.389 | 6.924 | 5.220 | 4.801 | 4.562 |
| **360** | 2.038 | 2.039 | 2.041 | 2.045 | 2.054 | 2.079 | 2.123 | 2.221 | 2.606 | 3.732 | 11.460 | 5.562 | 4.960 | 4.654 |
| **380** | 2.051 | 2.052 | 2.054 | 2.057 | 2.065 | 2.086 | 2.124 | 2.207 | 2.520 | 3.347 | 10.221 | 6.053 | 5.162 | 4.774 |
| **400** | 2.064 | 2.065 | 2.067 | 2.070 | 2.076 | 2.095 | 2.128 | 2.200 | 2.459 | 3.096 | 6.360 | 6.778 | 5.395 | 4.892 |
| **420** | 2.077 | 2.078 | 2.079 | 2.082 | 2.088 | 2.105 | 2.134 | 2.196 | 2.415 | 2.922 | 4.982 | 7.864 | 5.681 | 5.025 |
| **440** | 2.091 | 2.091 | 2.093 | 2.095 | 2.100 | 2.115 | 2.141 | 2.196 | 2.383 | 2.796 | 4.257 | 9.160 | 6.011 | 5.178 |
| **460** | 2.104 | 2.104 | 2.106 | 2.108 | 2.113 | 2.126 | 2.149 | 2.198 | 2.360 | 2.704 | 3.806 | 9.578 | 6.337 | 5.336 |
| **480** | 2.118 | 2.118 | 2.119 | 2.121 | 2.125 | 2.138 | 2.158 | 2.202 | 2.344 | 2.635 | 3.501 | 8.609 | 6.582 | 5.477 |
| **500** | 2.131 | 2.132 | 2.133 | 2.135 | 2.138 | 2.149 | 2.168 | 2.207 | 2.333 | 2.583 | 3.284 | 7.309 | 6.658 | 5.576 |
| **520** | 2.145 | 2.145 | 2.146 | 2.148 | 2.151 | 2.162 | 2.179 | 2.214 | 2.326 | 2.544 | 3.125 | 6.213 | 6.524 | 5.615 |
| **540** | 2.159 | 2.159 | 2.160 | 2.162 | 2.165 | 2.174 | 2.189 | 2.221 | 2.322 | 2.513 | 3.005 | 5.414 | 6.226 | 5.588 |
| **560** | 2.173 | 2.173 | 2.174 | 2.175 | 2.178 | 2.187 | 2.201 | 2.230 | 2.321 | 2.490 | 2.912 | 4.837 | 5.837 | 5.495 |
| **580** | 2.187 | 2.187 | 2.188 | 2.189 | 2.192 | 2.200 | 2.213 | 2.239 | 2.321 | 2.473 | 2.839 | 4.413 | 5.425 | 5.351 |
| **600** | 2.201 | 2.201 | 2.202 | 2.203 | 2.205 | 2.213 | 2.224 | 2.249 | 2.324 | 2.460 | 2.781 | 4.097 | 5.051 | 5.171 |
| **620** | 2.215 | 2.215 | 2.216 | 2.217 | 2.219 | 2.226 | 2.237 | 2.259 | 2.328 | 2.451 | 2.735 | 3.856 | 4.712 | 4.977 |
| **640** | 2.229 | 2.229 | 2.230 | 2.231 | 2.233 | 2.239 | 2.249 | 2.270 | 2.332 | 2.444 | 2.698 | 3.667 | 4.427 | 4.734 |
| **660** | 2.243 | 2.244 | 2.244 | 2.245 | 2.247 | 2.253 | 2.262 | 2.281 | 2.338 | 2.440 | 2.668 | 3.515 | 4.191 | 4.532 |
| **680** | 2.258 | 2.258 | 2.258 | 2.259 | 2.261 | 2.266 | 2.275 | 2.292 | 2.345 | 2.438 | 2.644 | 3.391 | 3.992 | 4.358 |
| **700** | 2.272 | 2.272 | 2.272 | 2.273 | 2.275 | 2.280 | 2.287 | 2.303 | 2.353 | 2.438 | 2.625 | 3.288 | 3.824 | 4.191 |
| **720** | 2.286 | 2.286 | 2.287 | 2.287 | 2.289 | 2.293 | 2.300 | 2.315 | 2.361 | 2.439 | 2.610 | 3.203 | 3.682 | 4.032 |
| **740** | 2.300 | 2.300 | 2.301 | 2.301 | 2.303 | 2.307 | 2.314 | 2.327 | 2.369 | 2.442 | 2.598 | 3.132 | 3.563 | 3.888 |
| **760** | 2.314 | 2.314 | 2.315 | 2.315 | 2.317 | 2.320 | 2.327 | 2.339 | 2.378 | 2.445 | 2.589 | 3.072 | 3.465 | 3.764 |
| **780** | 2.328 | 2.328 | 2.329 | 2.329 | 2.331 | 2.334 | 2.340 | 2.352 | 2.388 | 2.450 | 2.582 | 3.023 | 3.383 | 3.661 |
| **800** | 2.344 | 2.344 | 2.344 | 2.345 | 2.346 | 2.349 | 2.354 | 2.365 | 2.397 | 2.454 | 2.578 | 2.981 | 3.316 | 3.576 |

## Table T-7.Speed of Sound in Water and Steam (m.s$^{-1}$)

| | Pressure (MPa) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *t* (°C) | 0.01 | 0.02 | 0.05 | 0.1 | 0.2 | 0.5 | 1 | 2 | 5 | 10 | 20 | 50 | 75 | 100 |
| Sat. Liq. | 1540.0 | 1553.8 | 1556.6 | 1545.5 | 1520.7 | 1462.0 | 1391.6 | 1290.6 | 1088.4 | 847.7 | 422.2 | | | |
| Sat. Vap. | 440.5 | 449.5 | 462.2 | 472.1 | 481.9 | 493.8 | 500.9 | 504.7 | 498.2 | 472.4 | 384.5 | | | |
| 0 | 1402.3 | 1402.3 | 1402.4 | 1402.4 | 1402.6 | 1403.1 | 1403.8 | 1405.4 | 1410.2 | 1418.2 | 1434.5 | 1485.9 | 1530.6 | 1575.5 |
| 10 | 1447.4 | 1447.4 | 1447.5 | 1447.6 | 1447.7 | 1448.2 | 1449.0 | 1450.6 | 1455.3 | 1463.3 | 1479.6 | 1530.0 | 1573.3 | 1616.8 |
| 20 | 1483.3 | 1483.3 | 1483.3 | 1483.4 | 1483.6 | 1484.0 | 1484.8 | 1486.4 | 1491.2 | 1499.2 | 1515.3 | 1564.9 | 1607.2 | 1649.6 |
| 25 | 1498.0 | 1498.0 | 1498.1 | 1498.2 | 1498.3 | 1498.8 | 1499.6 | 1501.2 | 1506.0 | 1514.0 | 1530.1 | 1579.5 | 1621.4 | 1663.4 |
| 30 | 1510.8 | 1510.9 | 1510.9 | 1511.0 | 1511.1 | 1511.6 | 1512.4 | 1514.0 | 1518.8 | 1526.8 | 1543.0 | 1592.3 | 1634.1 | 1675.8 |
| 40 | 1531.2 | 1531.2 | 1531.2 | 1531.3 | 1531.5 | 1531.9 | 1532.8 | 1534.4 | 1539.2 | 1547.4 | 1563.7 | 1613.3 | 1655.0 | 1696.4 |
| 50 | 443.7 | 1545.2 | 1545.2 | 1545.3 | 1545.5 | 1546.0 | 1546.8 | 1548.5 | 1553.5 | 1561.8 | 1578.4 | 1628.7 | 1670.8 | 1712.2 |
| 60 | 450.7 | 1553.7 | 1553.8 | 1553.9 | 1554.0 | 1554.5 | 1555.4 | 1557.1 | 1562.3 | 1570.8 | 1587.9 | 1639.3 | 1682.0 | 1723.7 |
| 70 | 457.5 | 456.7 | 1557.5 | 1557.6 | 1557.8 | 1558.3 | 1559.2 | 1561.0 | 1566.3 | 1575.2 | 1592.9 | 1645.6 | 1689.1 | 1731.3 |
| 80 | 464.1 | 463.4 | 1557.0 | 1557.1 | 1557.2 | 1557.8 | 1558.7 | 1560.6 | 1566.2 | 1575.4 | 1593.7 | 1648.1 | 1692.6 | 1735.4 |
| 90 | 470.5 | 470.0 | 468.3 | 1552.8 | 1553.0 | 1553.5 | 1554.5 | 1556.5 | 1562.3 | 1571.9 | 1591.0 | 1647.2 | 1692.8 | 1736.3 |
| 100 | 476.9 | 476.4 | 475.0 | 472.3 | 1545.3 | 1545.9 | 1546.9 | 1549.0 | 1555.1 | 1565.1 | 1585.0 | 1643.2 | 1690.1 | 1734.4 |
| 110 | 483.1 | 482.7 | 481.4 | 479.3 | 1534.6 | 1535.2 | 1536.3 | 1538.4 | 1544.8 | 1555.4 | 1576.2 | 1636.5 | 1684.8 | 1730.0 |
| 120 | 489.2 | 488.9 | 487.8 | 485.9 | 1521.0 | 1521.7 | 1522.8 | 1525.1 | 1531.8 | 1543.0 | 1564.7 | 1627.4 | 1677.1 | 1723.4 |
| 130 | 495.3 | 495.0 | 494.0 | 492.3 | 488.8 | 1505.6 | 1506.8 | 1509.2 | 1516.3 | 1528.0 | 1550.8 | 1616.0 | 1667.4 | 1714.7 |
| 140 | 501.2 | 500.9 | 500.1 | 498.6 | 495.5 | 1487.0 | 1488.3 | 1490.8 | 1498.4 | 1510.7 | 1534.7 | 1602.5 | 1655.6 | 1704.3 |
| 150 | 507.1 | 506.8 | 506.0 | 504.7 | 502.0 | 1466.0 | 1467.4 | 1470.1 | 1478.1 | 1491.2 | 1516.5 | 1587.2 | 1642.2 | 1692.1 |
| 160 | 512.8 | 512.6 | 511.9 | 510.7 | 508.3 | 500.2 | 1444.3 | 1447.2 | 1455.7 | 1469.6 | 1496.2 | 1570.1 | 1627.1 | 1678.5 |
| 170 | 518.5 | 518.3 | 517.7 | 516.6 | 514.4 | 507.3 | 1418.9 | 1422.0 | 1431.1 | 1445.8 | 1474.0 | 1551.4 | 1610.4 | 1663.6 |
| 180 | 524.1 | 523.9 | 523.4 | 522.4 | 520.4 | 514.1 | 501.0 | 1394.6 | 1404.3 | 1420.1 | 1450.0 | 1531.0 | 1592.4 | 1647.3 |
| 190 | 529.7 | 529.5 | 529.0 | 528.1 | 526.3 | 520.6 | 509.7 | 1365.0 | 1375.4 | 1392.2 | 1424.0 | 1509.1 | 1572.9 | 1629.8 |
| 200 | 535.1 | 535.0 | 534.5 | 533.7 | 532.0 | 526.8 | 517.3 | 1333.2 | 1344.3 | 1362.3 | 1396.2 | 1485.8 | 1552.2 | 1611.2 |
| 220 | 545.8 | 545.7 | 545.3 | 544.6 | 543.2 | 538.9 | 531.2 | 512.6 | 1275.4 | 1296.1 | 1334.8 | 1434.7 | 1506.9 | 1570.7 |
| 240 | 556.3 | 556.2 | 555.9 | 555.3 | 554.1 | 550.4 | 544.0 | 529.5 | 1197.1 | 1221.1 | 1265.7 | 1378.0 | 1457.1 | 1526.2 |
| 260 | 566.6 | 566.5 | 566.2 | 565.6 | 564.6 | 561.5 | 556.1 | 544.1 | 1107.7 | 1136.3 | 1188.5 | 1316.0 | 1402.9 | 1478.1 |
| 280 | 576.6 | 576.5 | 576.2 | 575.8 | 574.9 | 572.2 | 567.5 | 557.4 | 518.9 | 1038.9 | 1102.1 | 1249.0 | 1345.1 | 1426.9 |
| 300 | 586.4 | 586.3 | 586.1 | 585.7 | 584.9 | 582.6 | 578.5 | 569.9 | 538.8 | 922.8 | 1004.3 | 1177.3 | 1284.3 | 1373.4 |
| 320 | 596.0 | 595.9 | 595.7 | 595.4 | 594.7 | 592.6 | 589.1 | 581.7 | 555.8 | 491.7 | 890.3 | 1101.5 | 1221.3 | 1318.5 |
| 340 | 605.4 | 605.3 | 605.1 | 604.8 | 604.2 | 602.4 | 599.3 | 592.9 | 570.9 | 522.2 | 751.1 | 1021.7 | 1157.0 | 1263.0 |
| 360 | 614.6 | 614.5 | 614.4 | 614.1 | 613.6 | 612.0 | 609.2 | 603.6 | 584.8 | 545.5 | 542.7 | 936.0 | 1091.6 | 1207.4 |
| 380 | 623.7 | 623.6 | 623.5 | 623.2 | 622.8 | 621.3 | 618.9 | 613.9 | 597.6 | 565.0 | 461.3 | 846.8 | 1023.5 | 1150.7 |
| 400 | 632.6 | 632.5 | 632.4 | 632.2 | 631.8 | 630.5 | 628.3 | 623.9 | 609.6 | 582.0 | 507.3 | 755.1 | 955.9 | 1093.3 |
| 420 | 641.3 | 641.3 | 641.2 | 641.0 | 640.6 | 639.4 | 637.5 | 633.5 | 620.9 | 597.3 | 538.7 | 666.1 | 890.2 | 1037.2 |
| 440 | 649.9 | 649.9 | 649.8 | 649.6 | 649.2 | 648.2 | 646.5 | 642.9 | 631.7 | 611.3 | 563.4 | 593.6 | 828.7 | 983.7 |
| 460 | 658.4 | 658.3 | 658.2 | 658.1 | 657.8 | 656.8 | 655.3 | 652.1 | 642.1 | 624.2 | 584.1 | 556.7 | 774.3 | 934.4 |
| 480 | 666.7 | 666.6 | 666.6 | 666.4 | 666.1 | 665.3 | 663.9 | 661.0 | 652.1 | 636.4 | 602.3 | 554.8 | 730.1 | 890.4 |
| 500 | 674.9 | 674.8 | 674.8 | 674.6 | 674.4 | 673.6 | 672.3 | 669.8 | 661.8 | 647.9 | 618.6 | 568.9 | 698.6 | 852.7 |
| 520 | 682.9 | 682.9 | 682.8 | 682.7 | 682.5 | 681.8 | 680.7 | 678.3 | 671.2 | 658.8 | 633.5 | 588.1 | 680.3 | 821.9 |
| 540 | 690.9 | 690.9 | 690.8 | 690.7 | 690.5 | 689.9 | 688.8 | 686.7 | 680.3 | 669.3 | 647.2 | 607.7 | 673.0 | 798.0 |
| 560 | 698.7 | 698.7 | 698.6 | 698.6 | 698.4 | 697.8 | 696.9 | 694.9 | 689.2 | 679.4 | 660.1 | 626.2 | 674.1 | 781.0 |
| 580 | 706.4 | 706.4 | 706.4 | 706.3 | 706.1 | 705.6 | 704.8 | 703.0 | 697.8 | 689.1 | 672.2 | 643.4 | 679.5 | 770.0 |
| 600 | 714.1 | 714.1 | 714.0 | 713.9 | 713.8 | 713.3 | 712.5 | 711.0 | 706.3 | 698.5 | 683.7 | 659.2 | 687.4 | 766.5 |
| 620 | 721.6 | 721.6 | 721.5 | 721.5 | 721.3 | 720.9 | 720.2 | 718.8 | 714.6 | 707.7 | 694.7 | 673.9 | 697.2 | 762.8 |
| 640 | 729.0 | 729.0 | 729.0 | 728.9 | 728.8 | 728.4 | 727.8 | 726.5 | 722.8 | 716.6 | 705.2 | 687.7 | 707.9 | 764.7 |
| 660 | 736.4 | 736.3 | 736.3 | 736.3 | 736.1 | 735.8 | 735.2 | 734.1 | 730.7 | 725.3 | 715.3 | 700.7 | 718.9 | 770.5 |
| 680 | 743.6 | 743.6 | 743.6 | 743.5 | 743.4 | 743.1 | 742.6 | 741.6 | 738.6 | 733.7 | 725.0 | 713.1 | 730.0 | 777.3 |
| 700 | 750.8 | 750.7 | 750.7 | 750.7 | 750.6 | 750.3 | 749.9 | 749.0 | 746.3 | 742.0 | 734.5 | 725.0 | 741.0 | 784.1 |
| 720 | 757.8 | 757.8 | 757.8 | 757.8 | 757.7 | 757.4 | 757.0 | 756.2 | 753.9 | 750.1 | 743.6 | 736.3 | 751.9 | 790.9 |
| 740 | 764.8 | 764.8 | 764.8 | 764.8 | 764.7 | 764.5 | 764.1 | 763.4 | 761.3 | 758.1 | 752.6 | 747.2 | 762.5 | 797.9 |
| 760 | 771.8 | 771.8 | 771.7 | 771.7 | 771.6 | 771.4 | 771.1 | 770.5 | 768.7 | 765.9 | 761.2 | 757.7 | 772.8 | 805.2 |
| 780 | 778.6 | 778.6 | 778.6 | 778.6 | 778.5 | 778.3 | 778.1 | 777.5 | 776.0 | 773.6 | 769.7 | 767.7 | 782.6 | 812.8 |
| 800 | 785.3 | 785.3 | 785.3 | 785.3 | 785.2 | 785.1 | 784.9 | 784.4 | 783.2 | 781.3 | 778.0 | 777.4 | 791.8 | 821.0 |

## Table T-8. Dynamic Viscosity of Water and Steam (μPa.s)

| | Pressure (MPa) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *t* (°C) | 0.01 | 0.02 | 0.05 | 0.1 | 0.2 | 0.5 | 1 | 2 | 5 | 10 | 20 | 50 | 75 | 100 |
| Sat. Liq. | 587.3 | 465.6 | 348.3 | 282.8 | 231.6 | 180.2 | 150.5 | 126.4 | 100.1 | 81.7 | 56.2 | | | |
| Sat. Vap. | 10.4 | 10.9 | 11.6 | 12.2 | 12.9 | 14.0 | 15.0 | 16.1 | 18.0 | 20.2 | 27.4 | | | |
| 0 | 1792.0 | 1791.9 | 1791.9 | 1791.8 | 1791.5 | 1790.9 | 1789.7 | 1787.5 | 1781.0 | 1770.6 | 1751.2 | 1704.7 | 1677.9 | 1660.6 |
| 10 | 1306.0 | 1306.0 | 1305.9 | 1305.9 | 1305.8 | 1305.5 | 1305.1 | 1304.2 | 1301.6 | 1297.4 | 1289.8 | 1272.2 | 1263.3 | 1259.3 |
| 20 | 1001.6 | 1001.6 | 1001.6 | 1001.6 | 1001.6 | 1001.5 | 1001.3 | 1001.0 | 1000.1 | 998.8 | 996.4 | 992.0 | 991.3 | 993.1 |
| 25 | 890.0 | 890.0 | 890.0 | 890.0 | 890.0 | 890.0 | 889.9 | 889.8 | 889.4 | 888.8 | 887.9 | 887.2 | 888.8 | 892.4 |
| 30 | 797.2 | 797.2 | 797.2 | 797.2 | 797.2 | 797.2 | 797.2 | 797.2 | 797.2 | 797.1 | 797.3 | 799.2 | 802.5 | 807.1 |
| 40 | 652.7 | 652.7 | 652.7 | 652.7 | 652.7 | 652.8 | 652.8 | 653.0 | 653.4 | 654.0 | 655.5 | 660.6 | 665.8 | 671.8 |
| 50 | 10.5 | 546.5 | 546.5 | 546.5 | 546.5 | 546.6 | 546.7 | 546.9 | 547.5 | 548.5 | 550.6 | 557.4 | 563.5 | 570.1 |
| 60 | 10.9 | 466.0 | 466.0 | 466.0 | 466.1 | 466.1 | 466.3 | 466.5 | 467.2 | 468.4 | 470.9 | 478.4 | 484.9 | 491.7 |
| 70 | 11.2 | 11.2 | 403.5 | 403.6 | 403.6 | 403.7 | 403.8 | 404.0 | 404.8 | 406.1 | 408.7 | 416.6 | 423.3 | 430.1 |
| 80 | 11.6 | 11.6 | 354.0 | 354.1 | 354.1 | 354.2 | 354.3 | 354.6 | 355.4 | 356.7 | 359.4 | 367.4 | 374.1 | 380.8 |
| 90 | 12.0 | 11.9 | 11.9 | 314.2 | 314.2 | 314.3 | 314.4 | 314.7 | 315.5 | 316.9 | 319.5 | 327.5 | 334.1 | 340.7 |
| 100 | 12.3 | 12.3 | 12.3 | 12.2 | 281.6 | 281.7 | 281.8 | 282.1 | 282.9 | 284.2 | 286.9 | 294.8 | 301.3 | 307.7 |
| 110 | 12.7 | 12.7 | 12.7 | 12.6 | 254.6 | 254.7 | 254.8 | 255.1 | 255.9 | 257.2 | 259.9 | 267.6 | 274.0 | 280.2 |
| 120 | 13.1 | 13.1 | 13.1 | 13.0 | 232.0 | 232.1 | 232.2 | 232.5 | 233.3 | 234.6 | 237.2 | 244.8 | 251.0 | 257.1 |
| 130 | 13.5 | 13.5 | 13.4 | 13.4 | 13.3 | 213.0 | 213.1 | 213.4 | 214.2 | 215.5 | 218.0 | 225.5 | 231.5 | 237.5 |
| 140 | 13.9 | 13.8 | 13.8 | 13.8 | 13.7 | 196.7 | 196.8 | 197.1 | 197.8 | 199.1 | 201.6 | 209.0 | 214.9 | 220.7 |
| 150 | 14.2 | 14.2 | 14.2 | 14.2 | 14.1 | 182.6 | 182.7 | 183.0 | 183.8 | 185.0 | 187.5 | 194.7 | 200.5 | 206.2 |
| 160 | 14.6 | 14.6 | 14.6 | 14.6 | 14.5 | 14.4 | 170.5 | 170.8 | 171.5 | 172.8 | 175.2 | 182.3 | 188.0 | 193.5 |
| 170 | 15.0 | 15.0 | 15.0 | 15.0 | 14.9 | 14.8 | 159.8 | 160.1 | 160.8 | 162.1 | 164.5 | 171.5 | 177.1 | 182.5 |
| 180 | 15.4 | 15.4 | 15.4 | 15.4 | 15.4 | 15.2 | 15.0 | 150.6 | 151.4 | 152.6 | 155.0 | 162.0 | 167.5 | 172.8 |
| 190 | 15.8 | 15.8 | 15.8 | 15.8 | 15.8 | 15.6 | 15.4 | 142.2 | 143.0 | 144.2 | 146.6 | 153.5 | 159.0 | 164.2 |
| 200 | 16.2 | 16.2 | 16.2 | 16.2 | 16.2 | 16.1 | 15.9 | 134.7 | 135.5 | 136.7 | 139.1 | 146.0 | 151.4 | 156.5 |
| 220 | 17.0 | 17.0 | 17.0 | 17.0 | 17.0 | 16.9 | 16.8 | 16.5 | 122.5 | 123.8 | 126.2 | 133.1 | 138.4 | 143.5 |
| 240 | 17.9 | 17.9 | 17.9 | 17.8 | 17.8 | 17.7 | 17.6 | 17.4 | 111.5 | 112.9 | 115.5 | 122.5 | 127.8 | 132.8 |
| 260 | 18.7 | 18.7 | 18.7 | 18.7 | 18.6 | 18.6 | 18.5 | 18.3 | 101.9 | 103.4 | 106.2 | 113.5 | 118.9 | 123.8 |
| 280 | 19.5 | 19.5 | 19.5 | 19.5 | 19.5 | 19.4 | 19.3 | 19.2 | 18.8 | 94.8 | 97.8 | 105.7 | 111.2 | 116.2 |
| 300 | 20.3 | 20.3 | 20.3 | 20.3 | 20.3 | 20.3 | 20.2 | 20.1 | 19.8 | 86.4 | 90.1 | 98.7 | 104.5 | 109.6 |
| 320 | 21.1 | 21.1 | 21.1 | 21.1 | 21.1 | 21.1 | 21.1 | 21.0 | 20.8 | 20.7 | 82.4 | 92.3 | 98.4 | 103.7 |
| 340 | 22.0 | 22.0 | 22.0 | 22.0 | 22.0 | 21.9 | 21.9 | 21.8 | 21.7 | 21.7 | 74.2 | 86.2 | 92.9 | 98.4 |
| 360 | 22.8 | 22.8 | 22.8 | 22.8 | 22.8 | 22.8 | 22.8 | 22.7 | 22.6 | 22.7 | 62.8 | 80.3 | 87.6 | 93.5 |
| 380 | 23.6 | 23.6 | 23.6 | 23.6 | 23.6 | 23.6 | 23.6 | 23.6 | 23.5 | 23.6 | 25.8 | 74.3 | 82.7 | 88.9 |
| 400 | 24.5 | 24.5 | 24.5 | 24.5 | 24.5 | 24.4 | 24.4 | 24.4 | 24.4 | 24.6 | 26.1 | 68.1 | 77.8 | 84.6 |
| 420 | 25.3 | 25.3 | 25.3 | 25.3 | 25.3 | 25.3 | 25.3 | 25.3 | 25.3 | 25.5 | 26.8 | 61.4 | 73.1 | 80.5 |
| 440 | 26.1 | 26.1 | 26.1 | 26.1 | 26.1 | 26.1 | 26.1 | 26.1 | 26.2 | 26.4 | 27.6 | 54.4 | 68.5 | 76.6 |
| 460 | 26.9 | 26.9 | 26.9 | 26.9 | 26.9 | 26.9 | 26.9 | 26.9 | 27.0 | 27.2 | 28.4 | 47.9 | 64.0 | 72.8 |
| 480 | 27.7 | 27.7 | 27.7 | 27.7 | 27.7 | 27.8 | 27.8 | 27.8 | 27.9 | 28.1 | 29.2 | 43.4 | 59.8 | 69.2 |
| 500 | 28.6 | 28.6 | 28.6 | 28.6 | 28.6 | 28.6 | 28.6 | 28.6 | 28.7 | 29.0 | 30.0 | 40.9 | 56.1 | 65.8 |
| 520 | 29.4 | 29.4 | 29.4 | 29.4 | 29.4 | 29.4 | 29.4 | 29.4 | 29.5 | 29.8 | 30.8 | 39.6 | 52.9 | 62.8 |
| 540 | 30.2 | 30.2 | 30.2 | 30.2 | 30.2 | 30.2 | 30.2 | 30.2 | 30.4 | 30.7 | 31.6 | 39.1 | 50.4 | 60.1 |
| 560 | 31.0 | 31.0 | 31.0 | 31.0 | 31.0 | 31.0 | 31.0 | 31.1 | 31.2 | 31.5 | 32.4 | 38.9 | 48.6 | 57.8 |
| 580 | 31.8 | 31.8 | 31.8 | 31.8 | 31.8 | 31.8 | 31.8 | 31.9 | 32.0 | 32.3 | 33.2 | 39.0 | 47.4 | 55.9 |
| 600 | 32.6 | 32.6 | 32.6 | 32.6 | 32.6 | 32.6 | 32.6 | 32.7 | 32.8 | 33.1 | 34.0 | 39.2 | 46.5 | 54.3 |
| 620 | 33.4 | 33.4 | 33.4 | 33.4 | 33.4 | 33.4 | 33.4 | 33.5 | 33.6 | 33.9 | 34.8 | 39.5 | 46.0 | 53.1 |
| 640 | 34.2 | 34.2 | 34.2 | 34.2 | 34.2 | 34.2 | 34.2 | 34.3 | 34.4 | 34.7 | 35.5 | 39.9 | 45.7 | 52.2 |
| 660 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.0 | 35.1 | 35.2 | 35.5 | 36.3 | 40.4 | 45.6 | 51.5 |
| 680 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.8 | 35.9 | 36.0 | 36.3 | 37.1 | 40.9 | 45.6 | 51.0 |
| 700 | 36.6 | 36.6 | 36.6 | 36.6 | 36.6 | 36.6 | 36.6 | 36.7 | 36.8 | 37.1 | 37.9 | 41.5 | 45.8 | 50.7 |
| 720 | 37.3 | 37.3 | 37.3 | 37.3 | 37.4 | 37.4 | 37.4 | 37.4 | 37.6 | 37.9 | 38.6 | 42.0 | 46.0 | 50.5 |
| 740 | 38.1 | 38.1 | 38.1 | 38.1 | 38.1 | 38.1 | 38.2 | 38.2 | 38.4 | 38.7 | 39.4 | 42.6 | 46.3 | 50.5 |
| 760 | 38.9 | 38.9 | 38.9 | 38.9 | 38.9 | 38.9 | 38.9 | 39.0 | 39.1 | 39.4 | 40.1 | 43.2 | 46.6 | 50.5 |
| 780 | 39.7 | 39.7 | 39.7 | 39.7 | 39.7 | 39.7 | 39.7 | 39.8 | 39.9 | 40.2 | 40.9 | 43.8 | 47.0 | 50.6 |
| 800 | 40.4 | 40.4 | 40.4 | 40.4 | 40.4 | 40.5 | 40.5 | 40.5 | 40.7 | 40.9 | 41.6 | 44.4 | 47.4 | 50.8 |

## Table T-9. Thermal Conductivity of Water and Steam (mW.m$^{-1}$.K$^{-1}$)

| | Pressure (MPa) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *t* (°C) | 0.01 | 0.02 | 0.05 | 0.1 | 0.2 | 0.5 | 1 | 2 | 5 | 10 | 20 | 50 | 75 | 100 |
| Sat. Liq. | 635.7 | 651.0 | 667.8 | 677.1 | 682.3 | 680.6 | 671.3 | 651.3 | 601.2 | 535.3 | 432.4 | | | |
| Sat. Vap. | 19.9 | 21.0 | 22.8 | 24.5 | 26.7 | 30.6 | 34.8 | 40.9 | 54.8 | 78.3 | 250.8 | | | |
| 0 | 555.6 | 555.6 | 555.6 | 555.7 | 555.7 | 556.0 | 556.3 | 557.1 | 559.3 | 563.0 | 570.1 | 589.6 | 603.9 | 616.6 |
| 10 | 578.7 | 578.7 | 578.7 | 578.8 | 578.8 | 579.0 | 579.4 | 580.0 | 581.9 | 585.1 | 591.3 | 608.4 | 621.1 | 632.7 |
| 20 | 598.0 | 598.0 | 598.0 | 598.0 | 598.1 | 598.2 | 598.5 | 599.1 | 600.9 | 603.7 | 609.3 | 625.0 | 636.9 | 647.9 |
| 25 | 606.5 | 606.5 | 606.5 | 606.5 | 606.6 | 606.7 | 607.0 | 607.6 | 609.3 | 612.0 | 617.4 | 632.7 | 644.3 | 655.1 |
| 30 | 614.3 | 614.4 | 614.4 | 614.4 | 614.4 | 614.6 | 614.9 | 615.4 | 617.1 | 619.8 | 625.0 | 639.9 | 651.4 | 662.1 |
| 40 | 628.4 | 628.5 | 628.5 | 628.5 | 628.5 | 628.7 | 629.0 | 629.5 | 631.1 | 633.7 | 638.8 | 653.3 | 664.7 | 675.3 |
| 50 | 20.3 | 640.6 | 640.6 | 640.6 | 640.7 | 640.8 | 641.1 | 641.6 | 643.2 | 645.7 | 650.8 | 665.3 | 676.6 | 687.4 |
| 60 | 21.0 | 651.0 | 651.0 | 651.0 | 651.1 | 651.2 | 651.5 | 652.0 | 653.6 | 656.1 | 661.2 | 675.8 | 687.3 | 698.3 |
| 70 | 21.8 | 21.8 | 659.7 | 659.8 | 659.8 | 660.0 | 660.2 | 660.8 | 662.3 | 664.9 | 670.1 | 684.9 | 696.7 | 708.0 |
| 80 | 22.6 | 22.6 | 667.0 | 667.0 | 667.1 | 667.2 | 667.5 | 668.0 | 669.6 | 672.3 | 677.5 | 692.7 | 704.8 | 716.5 |
| 90 | 23.4 | 23.4 | 23.5 | 672.8 | 672.9 | 673.0 | 673.3 | 673.8 | 675.5 | 678.2 | 683.6 | 699.2 | 711.7 | 723.7 |
| 100 | 24.2 | 24.2 | 24.4 | 24.6 | 677.3 | 677.4 | 677.7 | 678.3 | 680.0 | 682.8 | 688.3 | 704.5 | 717.4 | 729.8 |
| 110 | 25.0 | 25.1 | 25.2 | 25.4 | 680.4 | 680.6 | 680.9 | 681.4 | 683.2 | 686.1 | 691.8 | 708.5 | 721.8 | 734.7 |
| 120 | 25.9 | 25.9 | 26.0 | 26.2 | 682.2 | 682.4 | 682.7 | 683.3 | 685.1 | 688.1 | 694.1 | 711.3 | 725.1 | 738.4 |
| 130 | 26.7 | 26.8 | 26.9 | 27.1 | 27.5 | 683.1 | 683.4 | 684.0 | 685.9 | 689.0 | 695.2 | 713.0 | 727.3 | 741.1 |
| 140 | 27.6 | 27.7 | 27.8 | 28.0 | 28.4 | 682.6 | 682.9 | 683.6 | 685.5 | 688.8 | 695.1 | 713.7 | 728.4 | 742.7 |
| 150 | 28.5 | 28.6 | 28.7 | 28.8 | 29.2 | 681.0 | 681.4 | 682.1 | 684.1 | 687.4 | 694.1 | 713.3 | 728.6 | 743.4 |
| 160 | 29.4 | 29.5 | 29.6 | 29.7 | 30.1 | 31.2 | 679.0 | 679.7 | 681.6 | 685.1 | 691.9 | 711.9 | 727.7 | 743.0 |
| 170 | 30.3 | 30.4 | 30.5 | 30.6 | 31.0 | 32.1 | 675.7 | 676.4 | 678.5 | 682.1 | 689.0 | 709.5 | 726.0 | 741.8 |
| 180 | 31.3 | 31.3 | 31.4 | 31.6 | 31.9 | 32.9 | 34.8 | 672.0 | 674.3 | 678.0 | 685.3 | 706.3 | 723.3 | 739.7 |
| 190 | 32.2 | 32.2 | 32.3 | 32.5 | 32.8 | 33.8 | 35.6 | 666.7 | 669.1 | 673.0 | 680.6 | 702.5 | 719.9 | 736.8 |
| 200 | 33.2 | 33.2 | 33.3 | 33.4 | 33.7 | 34.6 | 36.3 | 660.4 | 662.9 | 667.0 | 675.0 | 697.9 | 715.6 | 733.1 |
| 220 | 35.1 | 35.2 | 35.2 | 35.4 | 35.6 | 36.4 | 37.9 | 41.3 | 647.7 | 652.3 | 661.1 | 686.1 | 705.5 | 723.9 |
| 240 | 37.1 | 37.1 | 37.2 | 37.3 | 37.6 | 38.3 | 39.6 | 42.5 | 628.9 | 634.0 | 643.8 | 671.3 | 692.3 | 712.2 |
| 260 | 39.2 | 39.2 | 39.3 | 39.4 | 39.6 | 40.2 | 41.4 | 43.9 | 606.1 | 612.0 | 623.2 | 653.6 | 676.5 | 697.9 |
| 280 | 41.3 | 41.3 | 41.3 | 41.4 | 41.6 | 42.2 | 43.2 | 45.4 | 54.2 | 586.0 | 598.9 | 633.1 | 658.3 | 681.4 |
| 300 | 43.4 | 43.4 | 43.4 | 43.5 | 43.7 | 44.2 | 45.1 | 47.0 | 54.3 | 555.1 | 570.8 | 610.0 | 637.7 | 662.8 |
| 320 | 45.5 | 45.6 | 45.6 | 45.7 | 45.8 | 46.3 | 47.1 | 48.8 | 55.0 | 74.1 | 537.9 | 584.2 | 615.0 | 642.4 |
| 340 | 47.7 | 47.8 | 47.8 | 47.9 | 48.0 | 48.4 | 49.2 | 50.7 | 56.0 | 70.0 | 497.8 | 555.5 | 590.3 | 620.2 |
| 360 | 50.0 | 50.0 | 50.0 | 50.1 | 50.2 | 50.6 | 51.3 | 52.6 | 57.4 | 68.6 | 443.9 | 523.8 | 563.6 | 596.5 |
| 380 | 52.3 | 52.3 | 52.3 | 52.4 | 52.5 | 52.8 | 53.4 | 54.7 | 58.9 | 68.3 | 126.7 | 488.4 | 535.1 | 571.5 |
| 400 | 54.6 | 54.6 | 54.6 | 54.6 | 54.8 | 55.1 | 55.6 | 56.8 | 60.6 | 68.7 | 103.7 | 448.3 | 504.8 | 545.3 |
| 420 | 56.9 | 56.9 | 56.9 | 57.0 | 57.1 | 57.4 | 57.9 | 58.9 | 62.4 | 69.6 | 95.5 | 402.2 | 472.7 | 518.3 |
| 440 | 59.3 | 59.3 | 59.3 | 59.3 | 59.4 | 59.7 | 60.2 | 61.2 | 64.4 | 70.8 | 91.8 | 348.6 | 438.9 | 490.6 |
| 460 | 61.6 | 61.7 | 61.7 | 61.7 | 61.8 | 62.1 | 62.5 | 63.4 | 66.4 | 72.3 | 90.2 | 291.0 | 403.9 | 462.5 |
| 480 | 64.1 | 64.1 | 64.1 | 64.1 | 64.2 | 64.5 | 64.9 | 65.8 | 68.6 | 74.0 | 89.7 | 241.0 | 368.4 | 434.3 |
| 500 | 66.5 | 66.5 | 66.5 | 66.6 | 66.7 | 66.9 | 67.3 | 68.1 | 70.8 | 75.9 | 90.0 | 206.0 | 333.8 | 406.6 |
| 520 | 69.0 | 69.0 | 69.0 | 69.1 | 69.1 | 69.4 | 69.7 | 70.5 | 73.1 | 77.9 | 90.9 | 183.4 | 302.1 | 379.9 |
| 540 | 71.5 | 71.5 | 71.5 | 71.6 | 71.6 | 71.8 | 72.2 | 73.0 | 75.4 | 80.1 | 92.1 | 169.0 | 274.8 | 354.9 |
| 560 | 74.0 | 74.0 | 74.0 | 74.1 | 74.1 | 74.4 | 74.7 | 75.5 | 77.9 | 82.3 | 93.7 | 159.9 | 252.4 | 332.1 |
| 580 | 76.5 | 76.6 | 76.6 | 76.6 | 76.7 | 76.9 | 77.3 | 78.0 | 80.3 | 84.7 | 95.5 | 154.0 | 235.0 | 311.9 |
| 600 | 79.1 | 79.1 | 79.1 | 79.2 | 79.2 | 79.5 | 79.8 | 80.5 | 82.8 | 87.1 | 97.4 | 150.4 | 221.7 | 294.5 |
| 620 | 81.7 | 81.7 | 81.7 | 81.8 | 81.8 | 82.0 | 82.4 | 83.1 | 85.4 | 89.6 | 99.6 | 148.2 | 211.8 | 279.8 |
| 640 | 84.3 | 84.3 | 84.3 | 84.4 | 84.4 | 84.6 | 85.0 | 85.7 | 88.0 | 92.1 | 101.9 | 147.2 | 204.5 | 267.7 |
| 660 | 86.9 | 86.9 | 86.9 | 87.0 | 87.1 | 87.3 | 87.6 | 88.3 | 90.6 | 94.7 | 104.3 | 146.9 | 199.2 | 257.9 |
| 680 | 89.6 | 89.6 | 89.6 | 89.6 | 89.7 | 89.9 | 90.3 | 91.0 | 93.3 | 97.3 | 106.7 | 147.3 | 195.4 | 249.9 |
| 700 | 92.2 | 92.2 | 92.2 | 92.3 | 92.4 | 92.6 | 92.9 | 93.7 | 95.9 | 100.0 | 109.3 | 148.0 | 192.5 | 242.9 |
| 720 | 94.9 | 94.9 | 94.9 | 95.0 | 95.0 | 95.2 | 95.6 | 96.3 | 98.6 | 102.7 | 112.0 | 149.4 | 191.4 | 238.8 |
| 740 | 97.6 | 97.6 | 97.6 | 97.6 | 97.7 | 97.9 | 98.3 | 99.1 | 101.4 | 105.5 | 114.7 | 151.1 | 191.1 | 235.9 |
| 760 | 100.3 | 100.3 | 100.3 | 100.4 | 100.4 | 100.7 | 101.0 | 101.8 | 104.1 | 108.3 | 117.5 | 153.1 | 191.3 | 234.0 |
| 780 | 103.0 | 103.0 | 103.0 | 103.1 | 103.2 | 103.4 | 103.8 | 104.5 | 106.9 | 111.1 | 120.3 | 155.2 | 192.0 | 232.8 |
| 800 | 105.7 | 105.7 | 105.8 | 105.8 | 105.9 | 106.1 | 106.5 | 107.3 | 109.7 | 113.9 | 123.1 | 157.5 | 193.1 | 232.2 |

## Table T-10. Prandtl Number of Water and Steam

| | Pressure (MPa) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *t* (°C) | 0.01 | 0.02 | 0.05 | 0.1 | 0.2 | 0.5 | 1 | 2 | 5 | 10 | 20 | 50 | 75 | 100 |
| Sat. Liq. | 3.86 | 2.99 | 2.19 | 1.76 | 1.44 | 1.14 | 0.99 | 0.89 | 0.84 | 0.94 | 3.02 | | | |
| Sat. Vap. | 1.01 | 1.01 | 1.02 | 1.03 | 1.05 | 1.11 | 1.17 | 1.25 | 1.46 | 1.84 | 4.99 | | | |
| **0** | 13.61 | 13.61 | 13.61 | 13.61 | 13.60 | 13.59 | 13.56 | 13.51 | 13.36 | 13.12 | 12.68 | 11.63 | 10.99 | 10.52 |
| **10** | 9.47 | 9.47 | 9.47 | 9.47 | 9.46 | 9.46 | 9.44 | 9.42 | 9.34 | 9.22 | 9.00 | 8.45 | 8.11 | 7.85 |
| **20** | 7.01 | 7.01 | 7.01 | 7.01 | 7.01 | 7.00 | 7.00 | 6.98 | 6.94 | 6.87 | 6.75 | 6.44 | 6.24 | 6.08 |
| **25** | 6.14 | 6.14 | 6.14 | 6.14 | 6.14 | 6.13 | 6.13 | 6.12 | 6.08 | 6.03 | 5.94 | 5.70 | 5.54 | 5.42 |
| **30** | 5.42 | 5.42 | 5.42 | 5.42 | 5.42 | 5.42 | 5.42 | 5.41 | 5.38 | 5.34 | 5.27 | 5.08 | 4.95 | 4.86 |
| **40** | 4.34 | 4.34 | 4.34 | 4.34 | 4.34 | 4.34 | 4.33 | 4.33 | 4.31 | 4.29 | 4.24 | 4.12 | 4.04 | 3.98 |
| **50** | 1.00 | 3.57 | 3.57 | 3.57 | 3.57 | 3.56 | 3.56 | 3.56 | 3.55 | 3.53 | 3.50 | 3.42 | 3.36 | 3.32 |
| **60** | 0.99 | 2.99 | 2.99 | 2.99 | 2.99 | 2.99 | 2.99 | 2.99 | 2.98 | 2.97 | 2.95 | 2.89 | 2.86 | 2.83 |
| **70** | 0.98 | 1.00 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.56 | 2.55 | 2.55 | 2.53 | 2.49 | 2.46 | 2.44 |
| **80** | 0.98 | 0.99 | 2.23 | 2.23 | 2.23 | 2.23 | 2.23 | 2.22 | 2.22 | 2.21 | 2.20 | 2.17 | 2.15 | 2.14 |
| **90** | 0.97 | 0.98 | 1.01 | 1.96 | 1.96 | 1.96 | 1.96 | 1.96 | 1.96 | 1.95 | 1.95 | 1.92 | 1.91 | 1.90 |
| **100** | 0.97 | 0.98 | 1.00 | 1.03 | 1.75 | 1.75 | 1.75 | 1.75 | 1.75 | 1.75 | 1.74 | 1.72 | 1.71 | 1.70 |
| **110** | 0.97 | 0.97 | 0.99 | 1.01 | 1.58 | 1.58 | 1.58 | 1.58 | 1.58 | 1.58 | 1.57 | 1.56 | 1.55 | 1.54 |
| **120** | 0.97 | 0.97 | 0.98 | 1.00 | 1.44 | 1.44 | 1.44 | 1.44 | 1.44 | 1.44 | 1.44 | 1.42 | 1.42 | 1.41 |
| **130** | 0.96 | 0.97 | 0.98 | 0.99 | 1.03 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.32 | 1.31 | 1.31 | 1.30 |
| **140** | 0.96 | 0.96 | 0.97 | 0.98 | 1.01 | 1.23 | 1.23 | 1.23 | 1.23 | 1.23 | 1.23 | 1.22 | 1.21 | 1.21 |
| **150** | 0.96 | 0.96 | 0.97 | 0.98 | 1.00 | 1.16 | 1.16 | 1.16 | 1.15 | 1.15 | 1.15 | 1.14 | 1.14 | 1.13 |
| **160** | 0.96 | 0.96 | 0.96 | 0.97 | 0.99 | 1.07 | 1.09 | 1.09 | 1.09 | 1.09 | 1.08 | 1.07 | 1.07 | 1.07 |
| **170** | 0.96 | 0.96 | 0.96 | 0.97 | 0.98 | 1.04 | 1.03 | 1.03 | 1.03 | 1.03 | 1.03 | 1.02 | 1.01 | 1.01 |
| **180** | 0.95 | 0.96 | 0.96 | 0.96 | 0.98 | 1.02 | 1.17 | 0.99 | 0.99 | 0.98 | 0.98 | 0.97 | 0.97 | 0.96 |
| **190** | 0.95 | 0.95 | 0.96 | 0.96 | 0.97 | 1.01 | 1.10 | 0.95 | 0.95 | 0.94 | 0.94 | 0.93 | 0.92 | 0.92 |
| **200** | 0.95 | 0.95 | 0.95 | 0.96 | 0.97 | 0.99 | 1.06 | 0.92 | 0.91 | 0.91 | 0.91 | 0.90 | 0.89 | 0.88 |
| **220** | 0.95 | 0.95 | 0.95 | 0.95 | 0.96 | 0.98 | 1.02 | 1.17 | 0.87 | 0.86 | 0.86 | 0.84 | 0.83 | 0.83 |
| **240** | 0.95 | 0.95 | 0.95 | 0.95 | 0.95 | 0.97 | 1.00 | 1.08 | 0.84 | 0.84 | 0.83 | 0.81 | 0.79 | 0.79 |
| **260** | 0.94 | 0.94 | 0.94 | 0.95 | 0.95 | 0.96 | 0.98 | 1.04 | 0.84 | 0.83 | 0.81 | 0.78 | 0.77 | 0.76 |
| **280** | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.95 | 0.97 | 1.01 | 1.26 | 0.84 | 0.82 | 0.77 | 0.75 | 0.74 |
| **300** | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.95 | 0.96 | 0.99 | 1.16 | 0.88 | 0.84 | 0.77 | 0.75 | 0.73 |
| **320** | 0.93 | 0.93 | 0.94 | 0.94 | 0.94 | 0.94 | 0.95 | 0.98 | 1.10 | 1.60 | 0.90 | 0.79 | 0.75 | 0.72 |
| **340** | 0.93 | 0.93 | 0.93 | 0.93 | 0.93 | 0.94 | 0.95 | 0.97 | 1.06 | 1.36 | 1.03 | 0.81 | 0.76 | 0.72 |
| **360** | 0.93 | 0.93 | 0.93 | 0.93 | 0.93 | 0.94 | 0.94 | 0.96 | 1.03 | 1.23 | 1.62 | 0.85 | 0.77 | 0.73 |
| **380** | 0.93 | 0.93 | 0.93 | 0.93 | 0.93 | 0.93 | 0.94 | 0.95 | 1.01 | 1.16 | 2.08 | 0.92 | 0.80 | 0.74 |
| **400** | 0.93 | 0.93 | 0.93 | 0.93 | 0.93 | 0.93 | 0.93 | 0.95 | 0.99 | 1.11 | 1.60 | 1.03 | 0.83 | 0.76 |
| **420** | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.93 | 0.93 | 0.94 | 0.98 | 1.07 | 1.40 | 1.20 | 0.88 | 0.78 |
| **440** | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.93 | 0.94 | 0.97 | 1.04 | 1.28 | 1.43 | 0.94 | 0.81 |
| **460** | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.93 | 0.93 | 0.96 | 1.02 | 1.20 | 1.58 | 1.00 | 0.84 |
| **480** | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.93 | 0.95 | 1.00 | 1.14 | 1.55 | 1.07 | 0.87 |
| **500** | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.93 | 0.95 | 0.99 | 1.09 | 1.45 | 1.12 | 0.90 |
| **520** | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.92 | 0.92 | 0.92 | 0.94 | 0.97 | 1.06 | 1.34 | 1.14 | 0.93 |
| **540** | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.92 | 0.92 | 0.93 | 0.96 | 1.03 | 1.25 | 1.14 | 0.95 |
| **560** | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.92 | 0.93 | 0.95 | 1.01 | 1.18 | 1.12 | 0.96 |
| **580** | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.92 | 0.93 | 0.94 | 0.99 | 1.12 | 1.09 | 0.96 |
| **600** | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.92 | 0.94 | 0.97 | 1.07 | 1.06 | 0.95 |
| **620** | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.91 | 0.92 | 0.93 | 0.95 | 1.03 | 1.02 | 0.94 |
| **640** | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.91 | 0.91 | 0.91 | 0.91 | 0.92 | 0.94 | 1.00 | 0.99 | 0.92 |
| **660** | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.91 | 0.91 | 0.92 | 0.93 | 0.97 | 0.96 | 0.91 |
| **680** | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.91 | 0.91 | 0.92 | 0.94 | 0.93 | 0.89 |
| **700** | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.91 | 0.92 | 0.91 | 0.88 |
| **720** | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.88 | 0.85 |
| **740** | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.89 | 0.89 | 0.88 | 0.86 | 0.83 |
| **760** | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.89 | 0.89 | 0.88 | 0.87 | 0.84 | 0.81 |
| **780** | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.89 | 0.89 | 0.89 | 0.88 | 0.85 | 0.83 | 0.80 |
| **800** | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 | 0.89 | 0.89 | 0.89 | 0.89 | 0.88 | 0.87 | 0.84 | 0.81 | 0.78 |

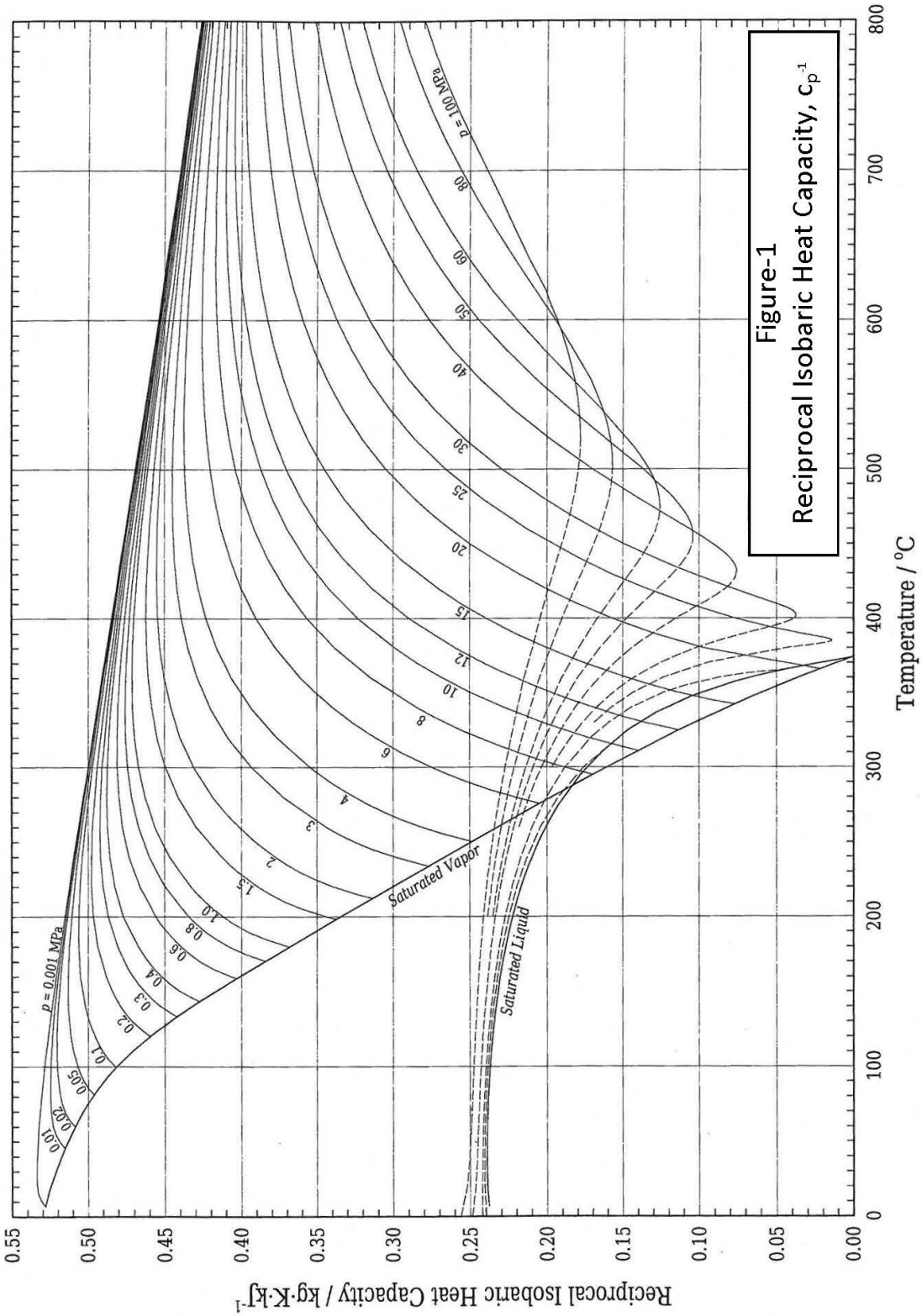
## Table T-11. Vapor-Liquid Surface Tension of Water and Steam ($mN.m^{-1}$)

| *t* (°C) | Surf. Tension |
|---|---|
| 0.01 | 75.65 |
| 5 | 74.94 |
| 10 | 74.22 |
| 15 | 73.49 |
| 20 | 72.74 |
| 25 | 71.97 |
| 30 | 71.19 |
| 35 | 70.40 |
| 40 | 69.60 |
| 45 | 68.78 |
| 50 | 67.94 |
| 55 | 67.10 |
| 60 | 66.24 |
| 65 | 65.37 |
| 70 | 64.48 |
| 75 | 63.58 |
| 80 | 62.67 |
| 85 | 61.75 |
| 90 | 60.82 |
| 95 | 59.87 |
| 100 | 58.91 |
| 105 | 57.94 |
| 110 | 56.96 |
| 115 | 55.97 |
| 120 | 54.97 |
| 125 | 53.96 |
| 130 | 52.93 |
| 135 | 51.90 |
| 140 | 50.86 |
| 145 | 49.80 |
| 150 | 48.74 |
| 155 | 47.67 |
| 160 | 46.59 |
| 165 | 45.50 |
| 170 | 44.41 |
| 175 | 43.30 |
| 180 | 42.19 |
| 185 | 41.07 |
| 190 | 39.95 |
| 195 | 38.81 |

| *t* (°C) | Surf. Tension |
|---|---|
| 200 | 37.67 |
| 205 | 36.53 |
| 210 | 35.38 |
| 215 | 34.23 |
| 220 | 33.07 |
| 225 | 31.90 |
| 230 | 30.74 |
| 235 | 29.57 |
| 240 | 28.39 |
| 245 | 27.22 |
| 250 | 26.04 |
| 255 | 24.87 |
| 260 | 23.69 |
| 265 | 22.51 |
| 270 | 21.34 |
| 275 | 20.16 |
| 280 | 18.99 |
| 285 | 17.83 |
| 290 | 16.66 |
| 295 | 15.51 |
| 300 | 14.36 |
| 305 | 13.22 |
| 310 | 12.09 |
| 315 | 10.97 |
| 320 | 9.86 |
| 325 | 8.77 |
| 330 | 7.70 |
| 335 | 6.65 |
| 340 | 5.63 |
| 345 | 4.63 |
| 350 | 3.67 |
| 355 | 2.74 |
| 360 | 1.88 |
| 365 | 1.08 |
| 370 | 0.39 |
| 373.946 | 0 |

# ANNEX B

( *Clause* 5 & 8 )



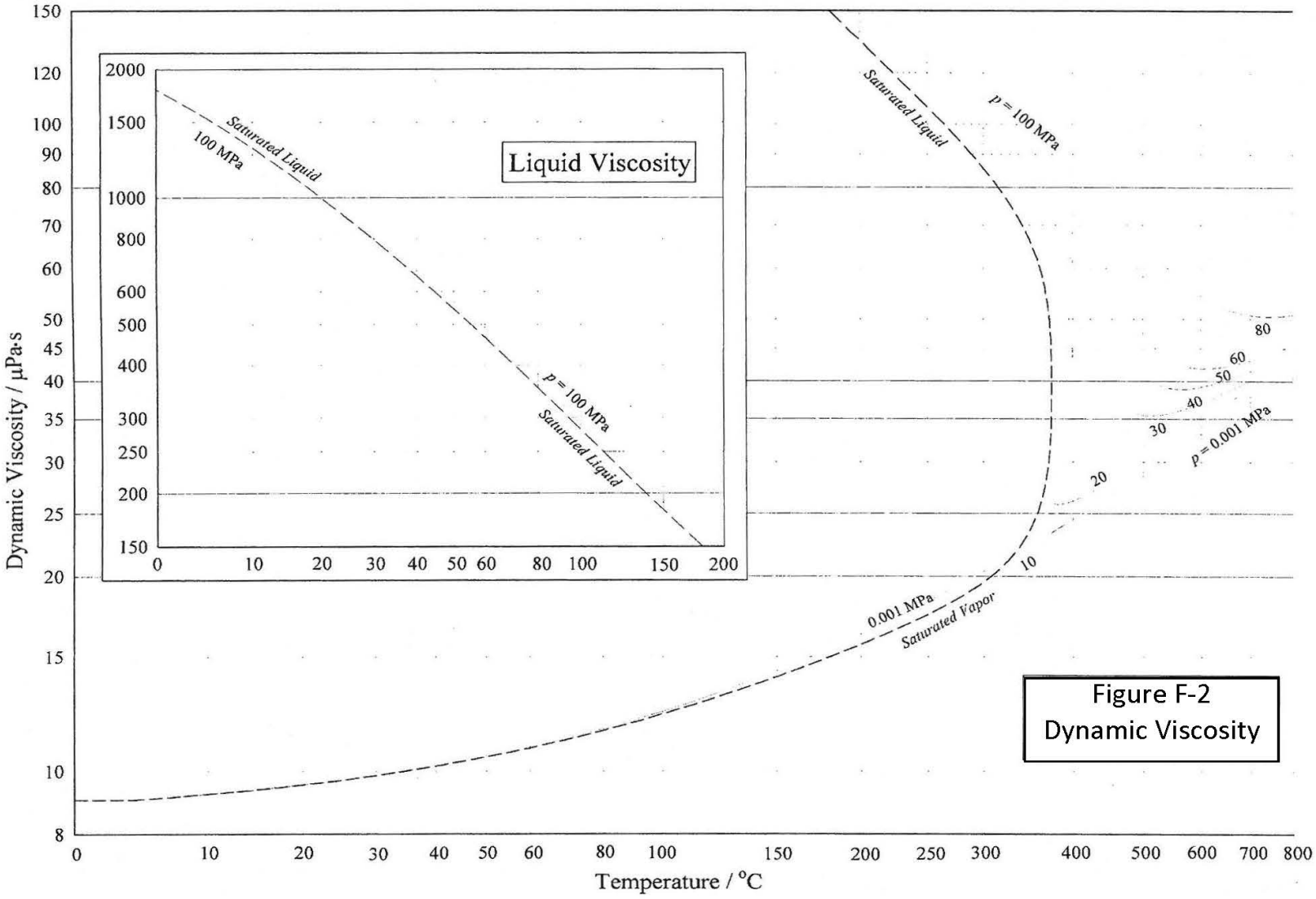



Figure F-2
Dynamic Viscosity

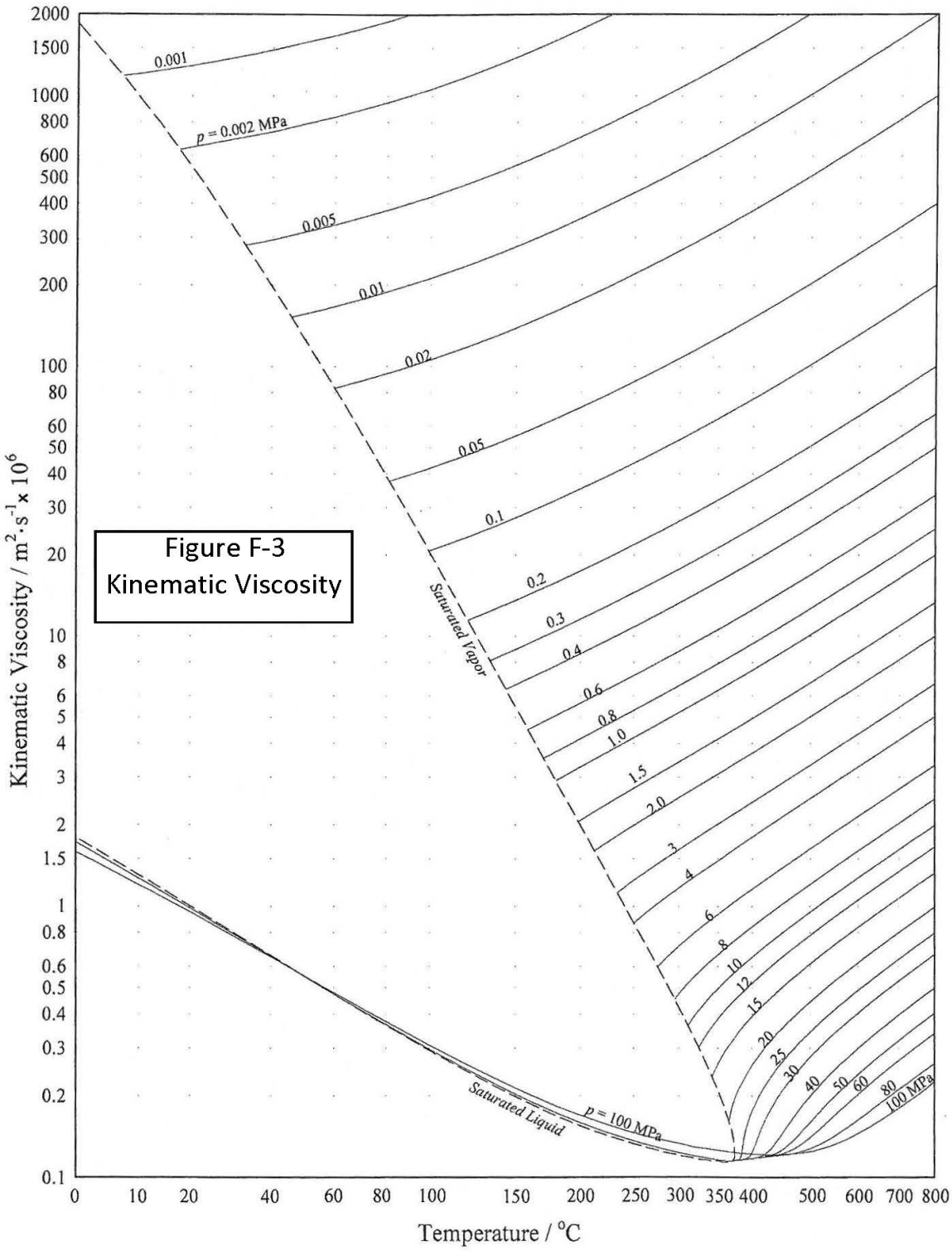


Figure F-3
Kinematic Viscosity
Kinematic Viscosity / m²·s⁻¹ x 10⁶
Temperature / °C
p = 0.002 MPa
0.001
0.005
0.01
0.02
0.05
0.1
0.2
0.3
0.4
0.6
0.8
1.0
1.5
2.0
3
4
6
8
10
12
15
20
25
30
40
50
60
80
100 MPa
Saturated Vapor
Saturated Liquid
p = 100 MPa

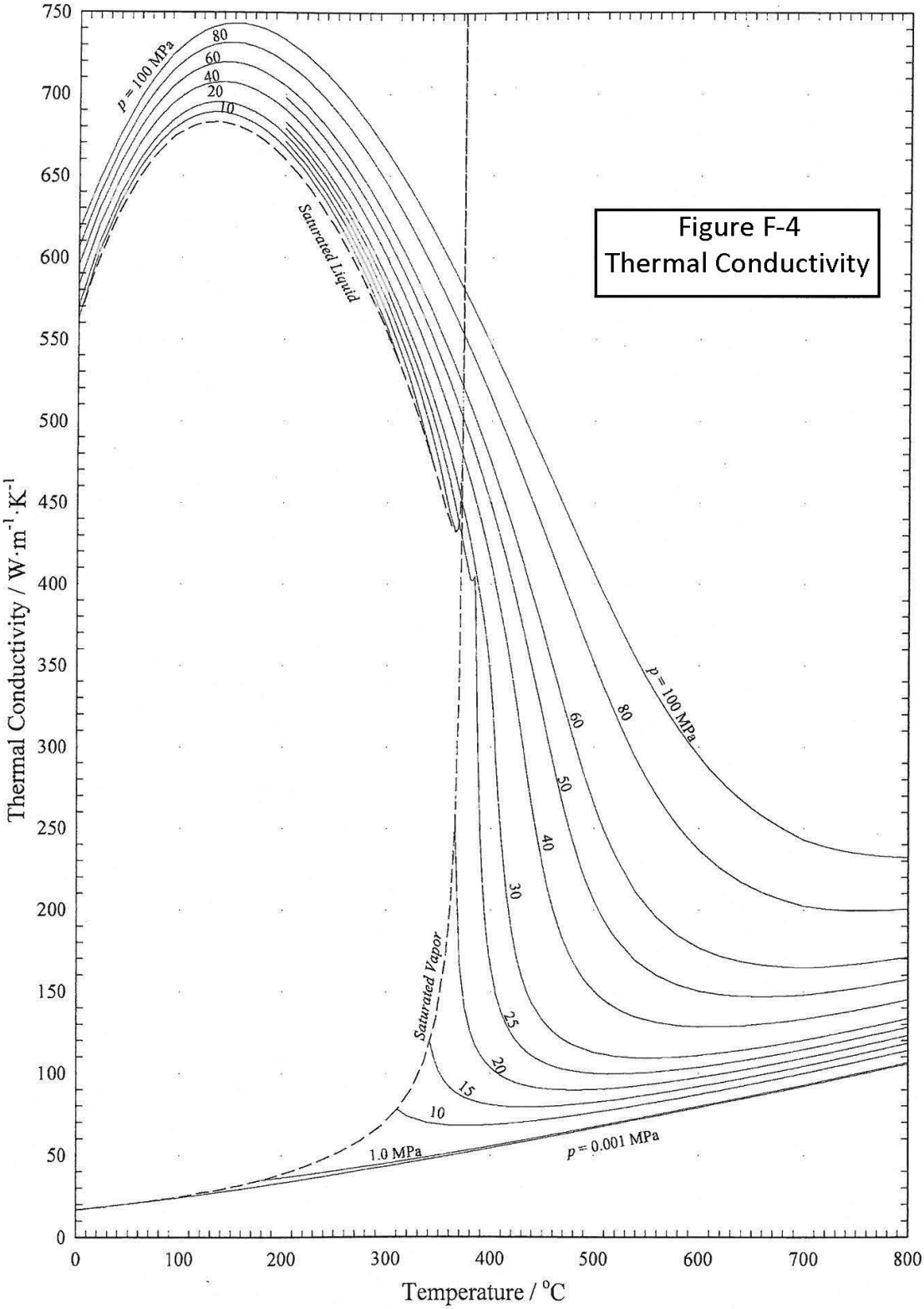


Figure F-4
Thermal Conductivity
Thermal Conductivity / W·m-1·K-1
Temperature / °C
p = 100 MPa
80
60
40
20
10
Saturated Liquid
Saturated Vapor
p = 100 MPa
80
60
50
40
30
25
20
15
10
1.0 MPa
p = 0.001 MPa
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
0
100
200
300
400
500
600
700
800

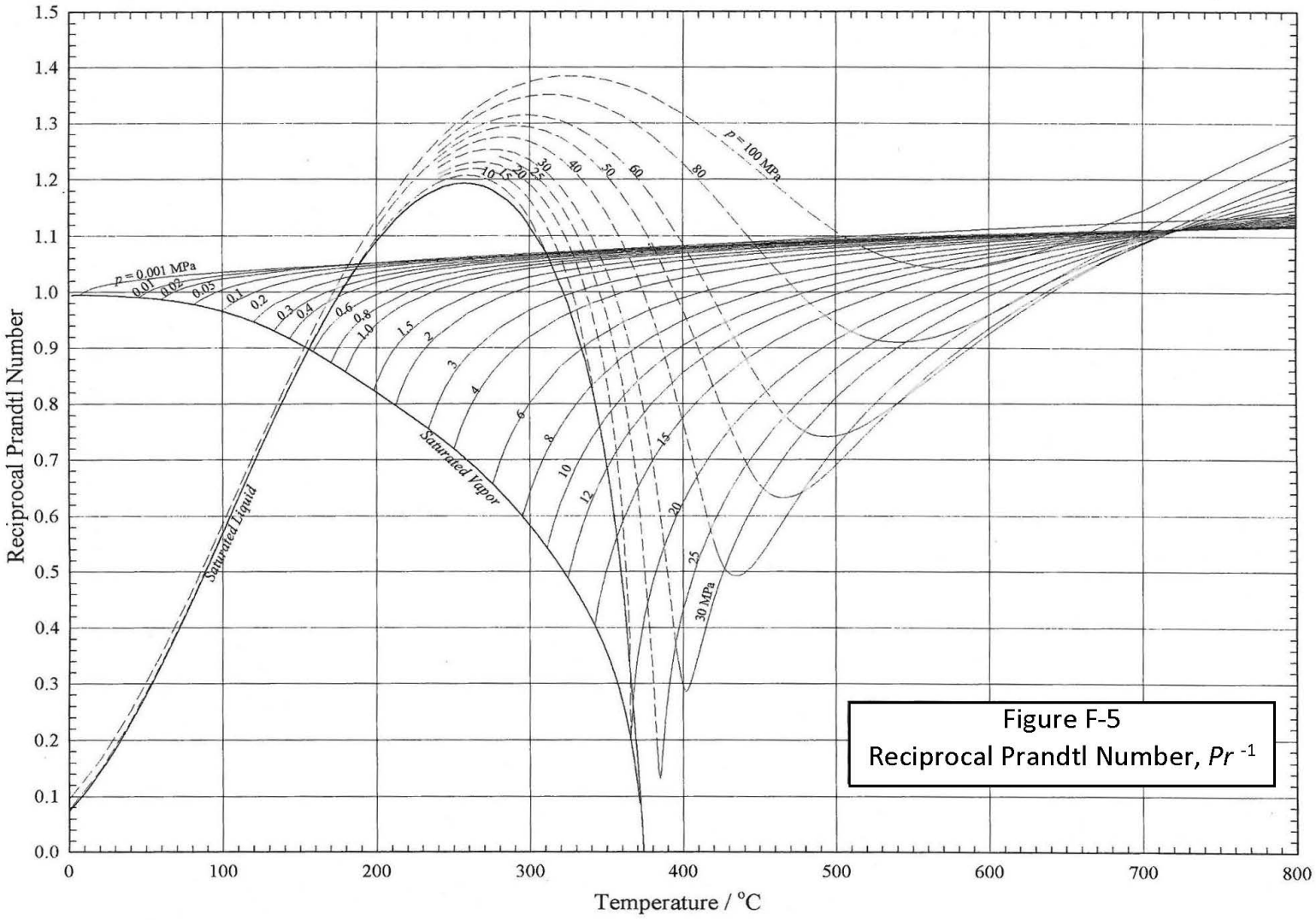



Figure F-5
Reciprocal Prandtl Number, $Pr^{-1}$

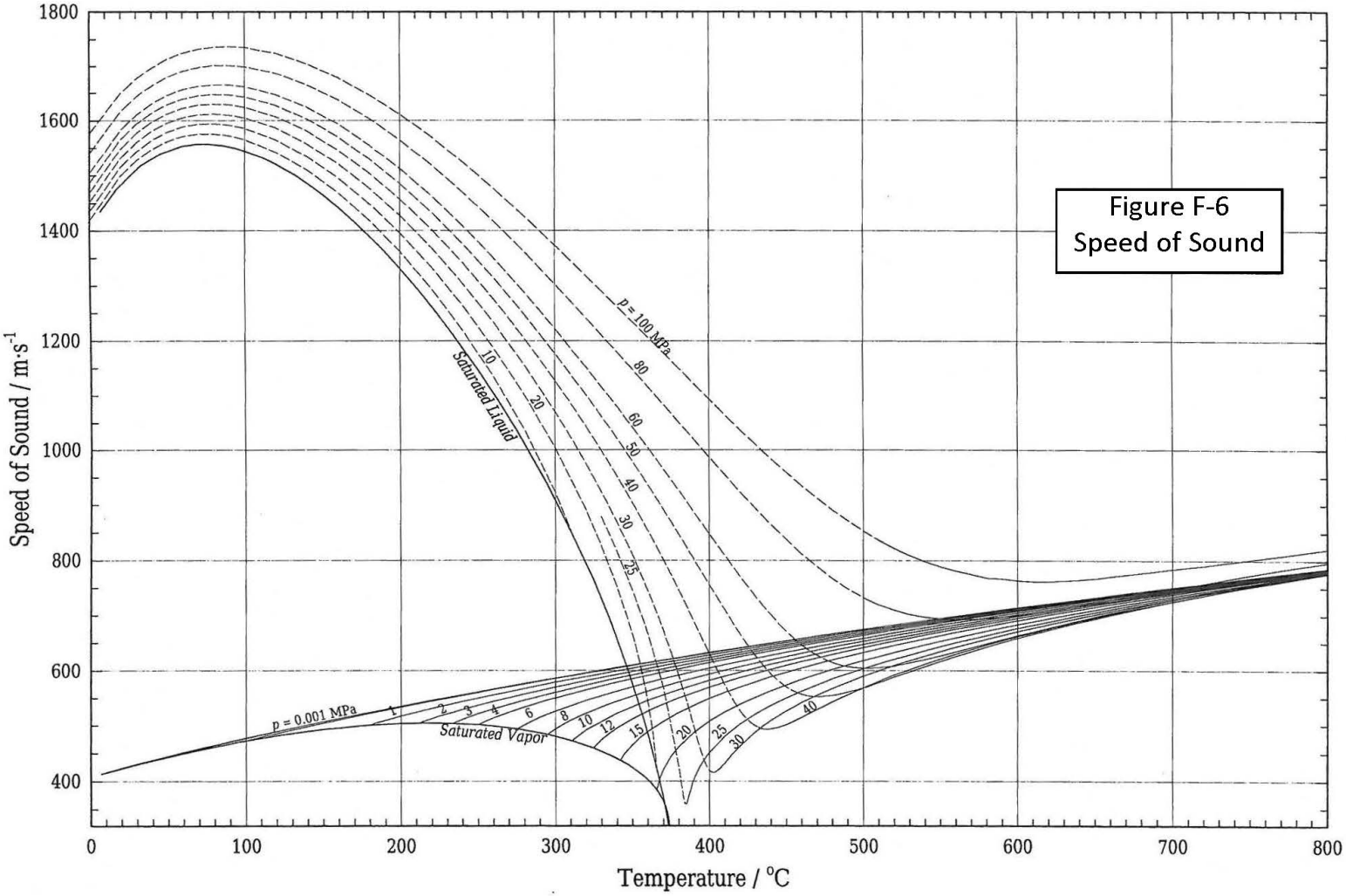



Figure F-6
Speed of Sound

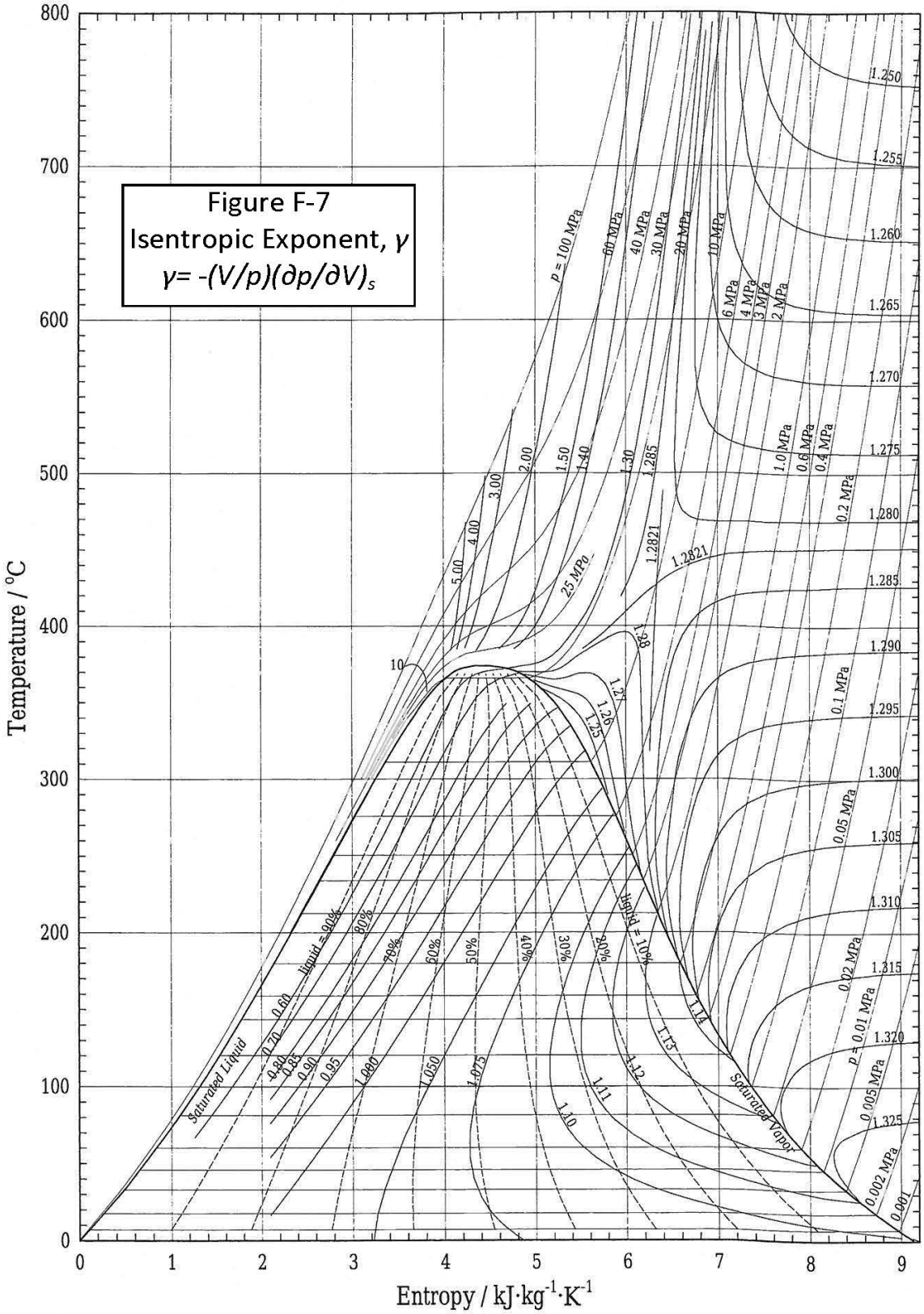


Figure F-7
Isentropic Exponent, γ
γ= -(V/p)(∂p/∂V)s
Temperature / °C
Entropy / kJ·kg-1·K-1
Saturated Liquid
Saturated Vapor
liquid = 90%
liquid = 10%
p = 100 MPa
60 MPa
40 MPa
30 MPa
20 MPa
10 MPa
6 MPa
4 MPa
3 MPa
2 MPa
1.0 MPa
0.6 MPa
0.4 MPa
0.2 MPa
0.1 MPa
0.05 MPa
0.02 MPa
p = 0.01 MPa
0.005 MPa
0.002 MPa
0.001
25 MPa
10
1.250
1.255
1.260
1.265
1.270
1.275
1.280
1.285
1.290
1.295
1.300
1.305
1.310
1.315
1.320
1.325
1.2821
1.28
1.27
1.26
1.25
1.30
1.285
1.50
1.40
2.00
3.00
4.00
5.00
0.60
0.70
0.80
0.85
0.90
0.95
1.000
1.050
1.075
1.10
1.11
1.12
1.13
1.14
90%
80%
70%
60%
50%
40%
30%
20%
10%

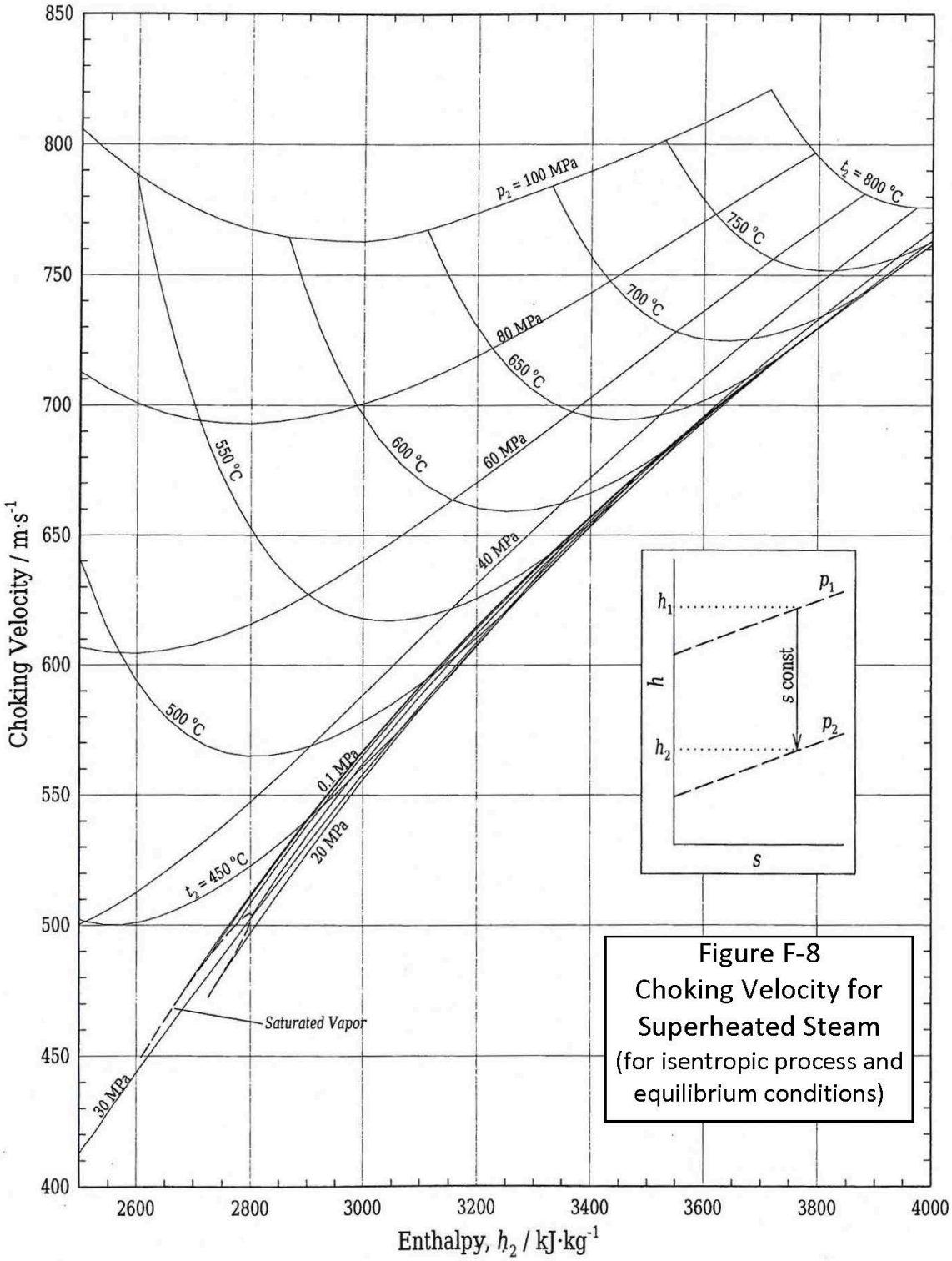



Figure F-8
Choking Velocity for Superheated Steam
(for isentropic process and equilibrium conditions)

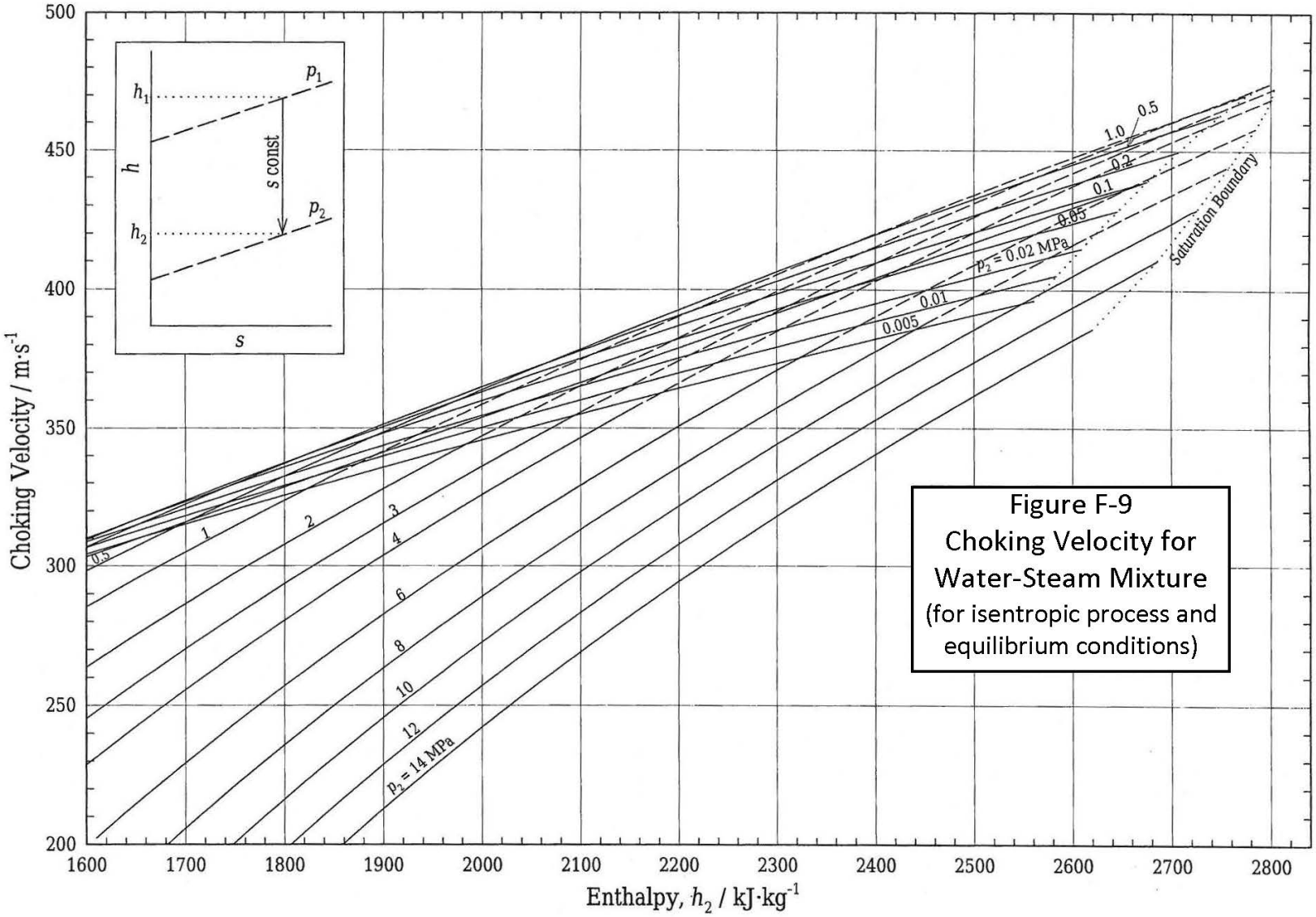



Figure F-9
Choking Velocity for Water-Steam Mixture
(for isentropic process and equilibrium conditions)

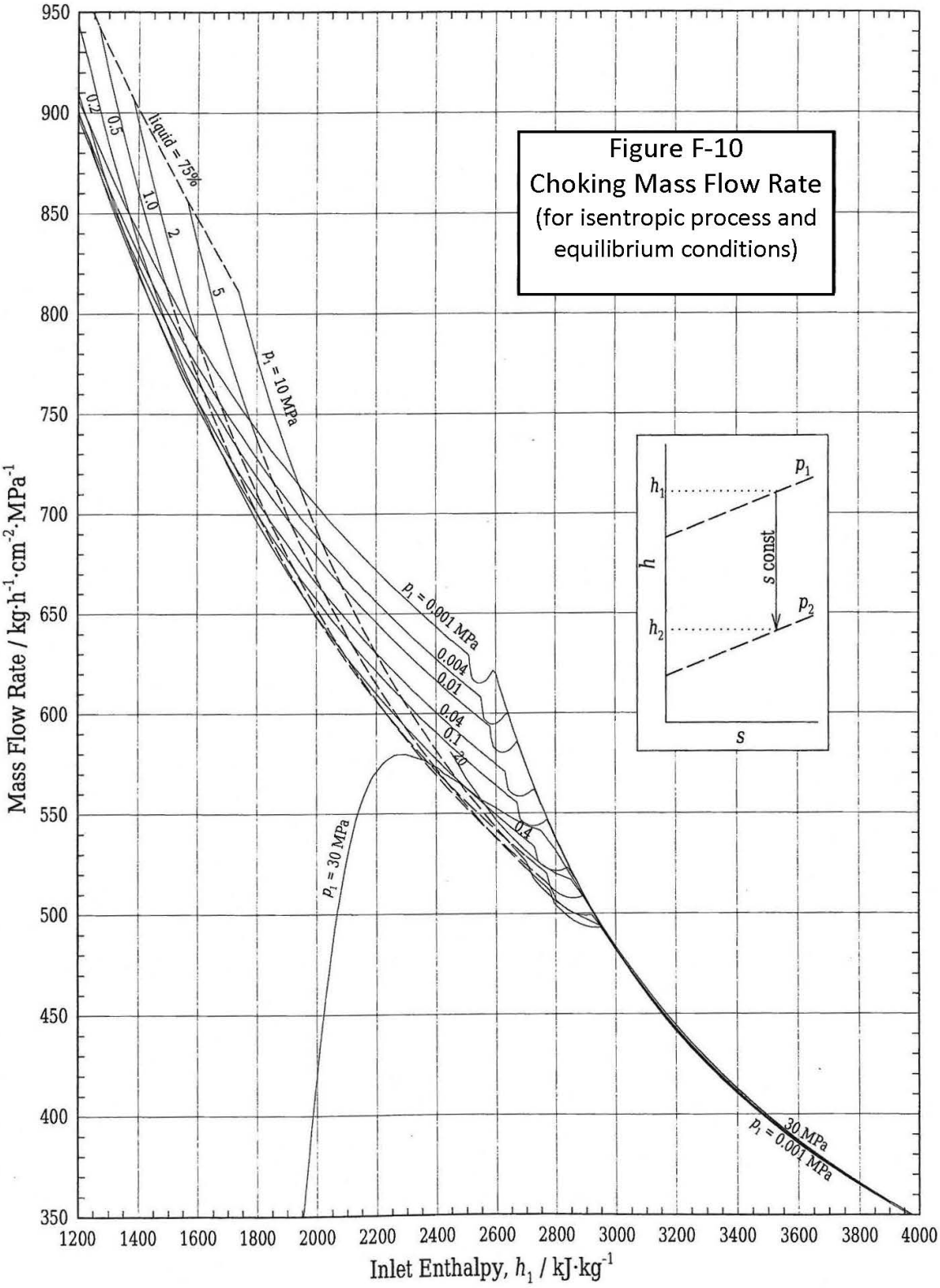


Figure F-10
Choking Mass Flow Rate
(for isentropic process and equilibrium conditions)
Mass Flow Rate / kg·h⁻¹·cm⁻²·MPa⁻¹
Inlet Enthalpy, h1 / kJ·kg⁻¹
950
900
850
800
750
700
650
600
550
500
450
400
350
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
liquid = 75%
0.2
0.5
1.0
2
5
p1 = 10 MPa
p1 = 0.001 MPa
0.004
0.01
0.04
0.1
20
0.4
p1 = 30 MPa
30 MPa
p1 = 0.001 MPa
h1
h2
h
s const
p1
p2
s

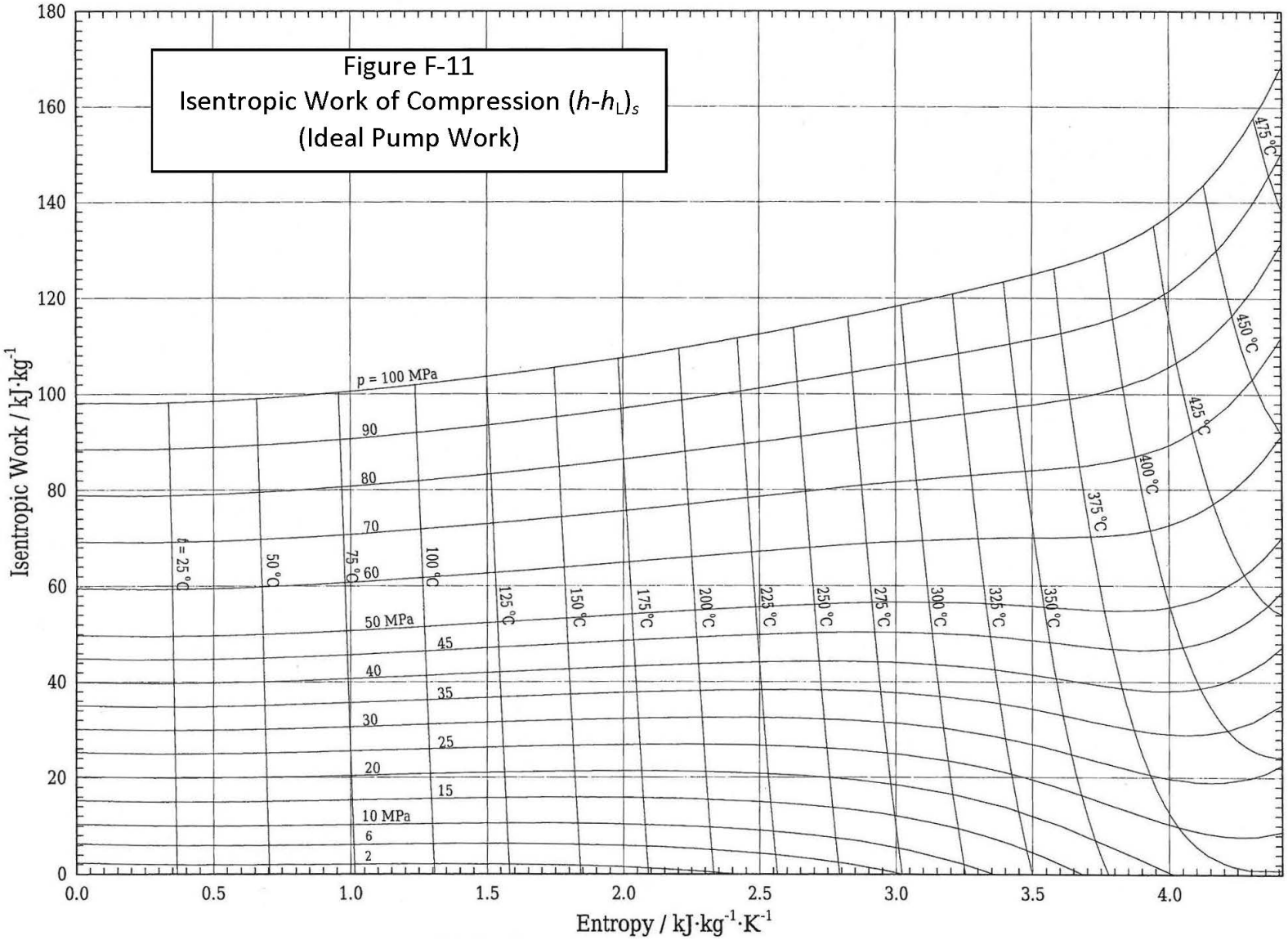
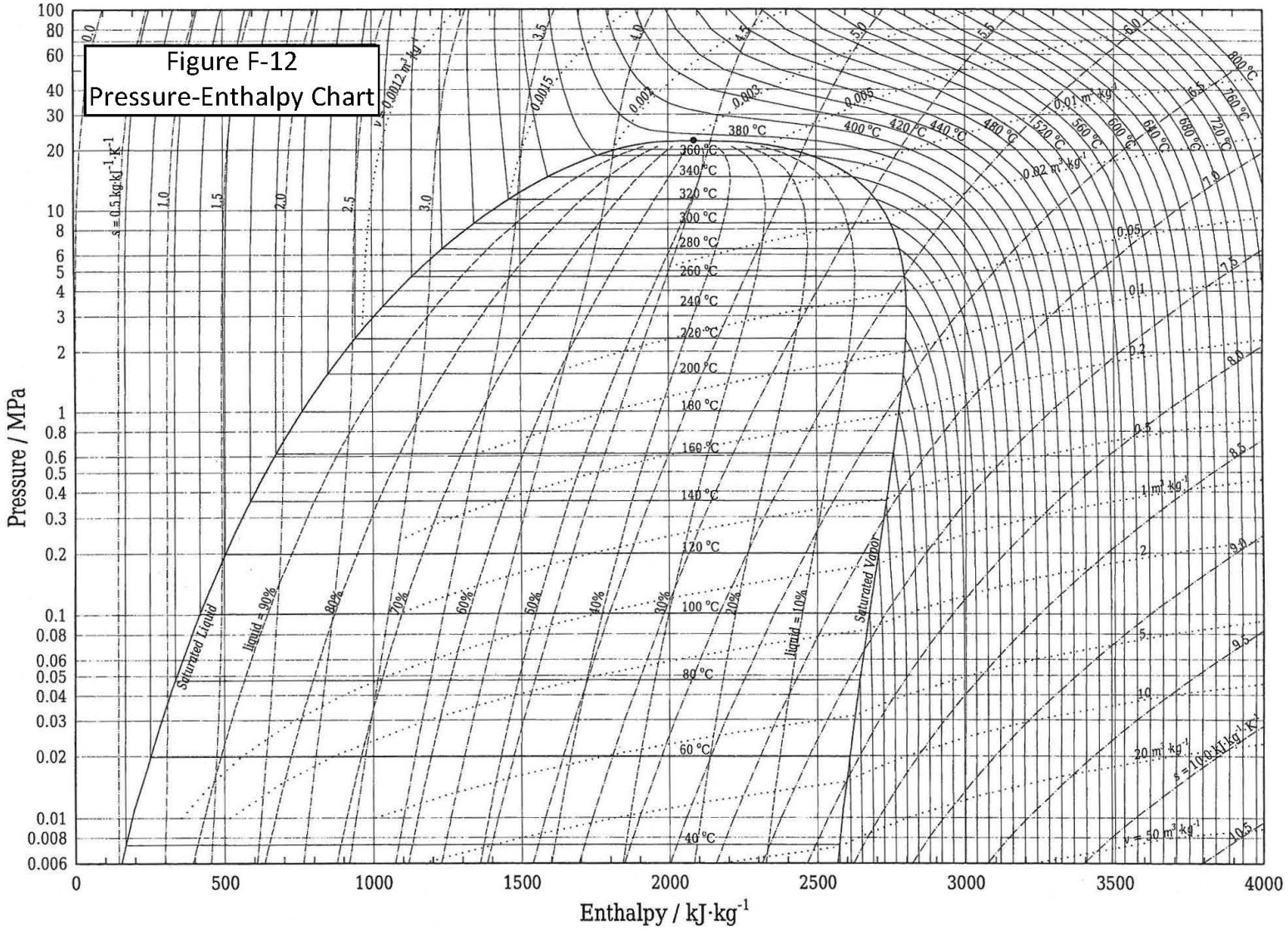



Figure F-11
Isentropic Work of Compression $(h\text{-}h_L)_s$
(Ideal Pump Work)

Figure F-12
Pressure-Enthalpy Chart



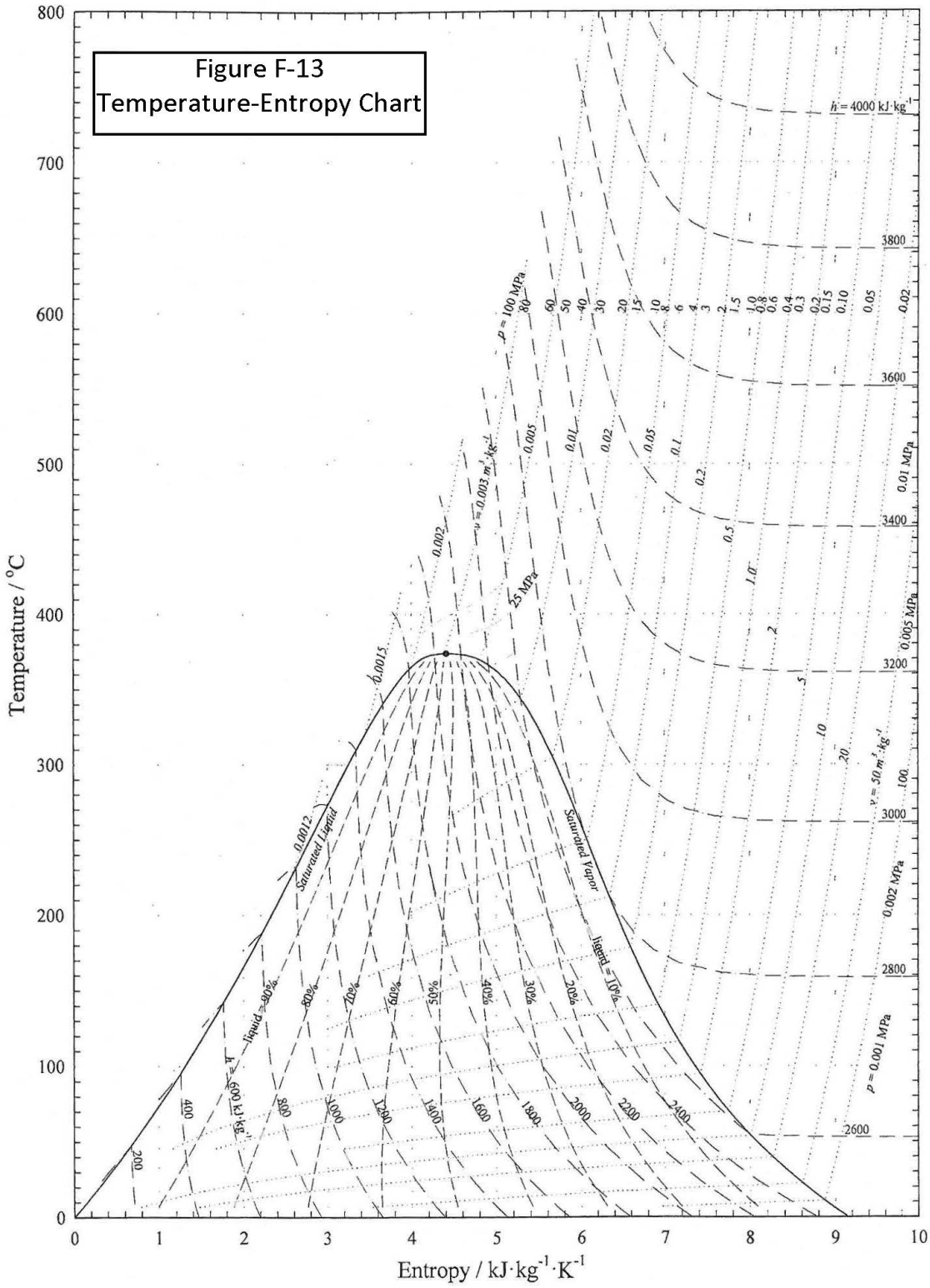


Figure F-13
Temperature-Entropy Chart
Temperature / °C
Entropy / kJ·kg⁻¹·K⁻¹
Saturated Liquid
Saturated Vapor
liquid = 90%
liquid = 10%
h = 4000 kJ·kg⁻¹
p = 100 MPa
25 MPa
p = 0.001 MPa

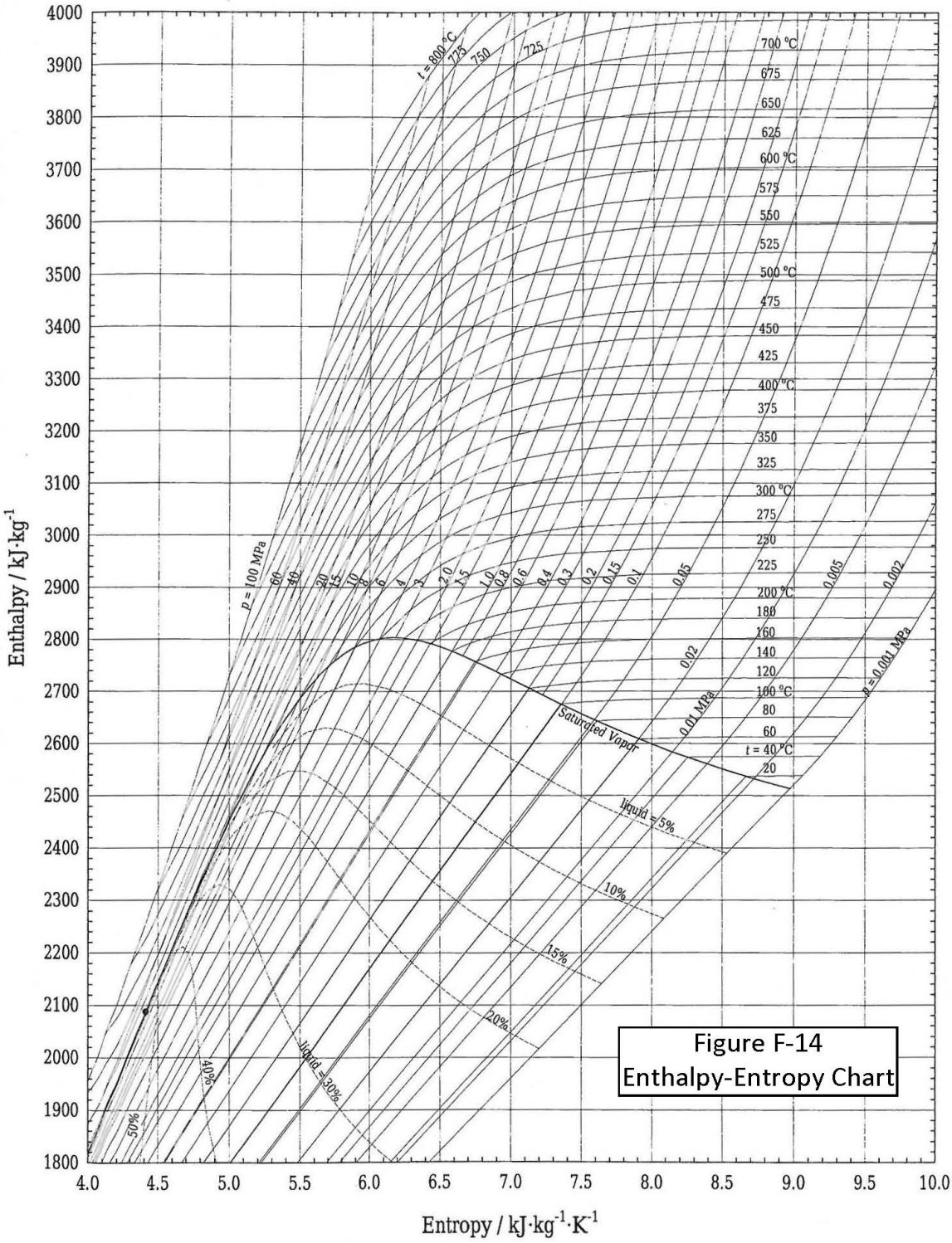



Figure F-14
Enthalpy-Entropy Chart

# ANNEX C

( *Foreword* )

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# ANNEX D

( *Foreword* )

## COMMITTEE COMPOSITION

Boilers and Pressure Vessels Sectional Committee, MED 01

| *Organization* | *Representative(s)* |
|---|---|
| Central Boilers Board, New Delhi | Shri T. S. G. Narayannen (***Chairman***)<br>Shri S. K. Jain (*Alternate*) |
| Bharat Heavy Electricals Ltd, Haridwar | Shri R. K. Chandra<br>Shri Shashi Kant (*Alternate*) |
| Bharat Heavy Electricals Ltd, Hyderabad | Shri Bhargav T. S. N<br>Shri Kishore Kumar K. (*Alternate*) |
| Bharat Heavy Electricals Ltd, Tiruchirapalli | Shri A. K. Shanmugam<br>Shri S. Anand Kumar (*Alternate*) |
| Bharat Petroleum Corporation Limited, Mumbai | Shri K. Rajashekar<br>Shri Sathyan V. (*Alternate*) |
| Bureau Veritas (I) Pvt Ltd, Mumbai | Shri Ranjit D. Naik<br>Shri T. R. Subramanian (*Alternate*) |
| Central Electricity Authority, New Delhi | Shri S. K. Kassi<br>Shri Rajesh Kumar Kohli (*Alternate*) |
| CSIR-CMERI, Durgapur | Dr Atanu Saha<br>Shri Kamal Kishor J. Uke (*Alternate*) |
| Director General of Factory Adviser Services and Labour Institute, Mumbai | Shri Sumit Roy<br>Shri Upendra Singh (*Alternate*) |
| Engineers India Limited, New Delhi | Shri R. K. Gulati<br>Shri R. K. Trivedi (*Alternate*) |
| GE Power, Noida | Shri G. Gopinath<br>Shri M. Anandhan (*Alternate*) |
| Godrej & Boyce Manufacturing Corporation Ltd, Mumbai | Shri Vasudev P. Shenoy<br>Shri Jayvant G. Pingale (*Alternate*) |
| Hindustan Petroleum Corporation Ltd, Mumbai | Shri Y. Sriramulu<br>Shri Mutnury Somasunder (*Alternate*) |
| Indian Boilers Manufacturer's Association, Mumbai | Shri Kishor Tapaswi |
| Indian Oil Corporation Ltd, Vadodara | Shri U. S. Prasad<br>Shri R. K. Sabharwal (*Alternate*) |
| Indian Register of Shipping, Mumbai | Shri R. Ravi<br>Shri Pradeep Bansal (*Alternate*) |
| Indira Gandhi Centre for Atomic Research, Department of Atomic Energy, Kalpakkam | Shri B. K. Sreedhar<br>Shri V. Vinod (*Alternate*) |
| Industrial Boilers Ltd, Mumbai | Shri Cyrus R. Engineer<br>Shri R. R. Engineer (*Alternate*) |
| L & T – Sargent & Lundy Ltd, Mumbai | Shri Y. D. Mishra<br>Shri Karthik T. (*Alternate*) |
| Larsen & Toubro Ltd, Mumbai | Shri Girish Y. Savant<br>Shri M. Venkatesh (*Alternate*) |

| *Organization* | *Representative(s)* |
|---|---|
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| Oil Industries Safety Directorate, New Delhi | Shri S. C. Gupta<br>Shri S. K. Sharma (*Alternate*) |
| Petroleum and Explosives Safety Organization, Nagpur | Shri D. K. Gupta<br>Shri V. B. Borgaonkar (*Alternate*) |
| Projects and Development India Ltd, Noida | Shri Y. K. Gautam<br>Shri Rajeev R. Kumar (*Alternate*) |
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| Tata Steel Ltd, Jamshedpur | Shri Braj Bihari Prasad<br>Shri Pradip Chakraborty (*Alternate*) |
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Ms Khashboo Kumari
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